Radical Sharing

to integrate affordable, sustainable housing in business parks

GRADUATION REPORT

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Advanced Housing Design: Ecologies of Inclusion
MSc Graduation Studio
TU Delft, 2025-26

Berkel en Rodenrijs

Colophon

Mila Giovacchini

**Advanced Housing Design:
Ecologies of Inclusion**

MSc Graduation Studio 2025/2026

Student number: 6301452

Course Code: AR4AD150

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Responsible tutor: Olv Klijn

The Studio

The graduation studio was organised in two phases: group research and individual design.

In the first quarter, we worked in groups on one housing theme and one landscape theme in Midden-Delfland. Our group focused on housing affordability, and the morphology of the Midden-Delfland landscape.

We then selected a site and developed a preliminary masterplan together by the end of January. This phase established the spatial framework, urban strategy, and shared ambitions for the area, while allowing each member to define their own potential contribution.

From February to early June, the project continued individually. Each student designed one or more housing buildings, that propose a specific ecology of inclusion within the shared materplan framework.

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Geerten Kalter, via Google Maps

Part 1

Introduction

1. Problem Statement
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1. Problem Statement

Housing Crisis

Europe and the Netherlands face a dual housing crisis: availability and affordability. Housing supply has failed to keep pace with demand (see figure 1), while rising land values and profit-driven development have increased costs. As a result, a growing share of households spend a lot more than 30% of their income on housing, and home ownership has become increasingly inaccessible.

Housing must also respond to changing social needs. Households are becoming smaller and more diverse, while loneliness and social isolation are rising. The housing crisis is therefore not only quantitative and financial, but also social: many *existing housing models no longer reflect how people live today.*

Contested Urban Land

Urban land is a highly contested resource. Housing development often out-competes industrial, logistical, and infrastructural functions, pushing these uses to peripheral or greenfield sites. This increases transport distances, land consumption, and emissions, and reduces space for productive activity within cities.
At the same time, continuing *urban expansion places pressure on valuable open landscapes*. The challenge is then not just to build more homes, but to do so without further damaging ecological systems or displacing essential urban functions.

Environmental Limits and Construction

The housing challenge is intensified by climate change and resource scarcity. The construction sector is one of the world's most carbon-intensive and resource-hungry industries, both during construction and building operation (see figure 2). New housing must reduce embodied carbon, minimise energy demand, and make efficient use of finite resources.

These pressures challenge us to rethink conventional housing and comfort standards. Future housing may need to provide high quality of life with less private space, more shared resources, and buildings that are adaptable, durable, and demountable.

Current Architectural Debate

Current architectural debate has proposed several responses to these overlapping crises. *Densification* seeks to optimise infrastructure, mobility, and land efficiency. *Mixed-use development* is promoted as a way to intensify land use and retain productive activities within urban areas. *Collective and collaborative living* models have regained attention for their potential to lower housing costs, reduce environmental impact, and strengthen social connection.

Figure 1. Housing shortage in the Netherlands (NOS, 2025)

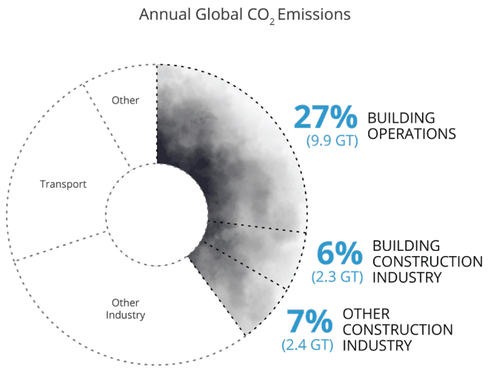


Figure 2. Building industry emissions. *Architecture 2030*

1. Problem Statement

Studio Context: Midden-Delfland

This graduation studio is set in Midden-Delfland, a protected green landscape between the expanding cities of the Randstad. The area is under pressure from urban growth and infrastructure development. At the same time, Dutch polder and peat landscapes face major environmental challenges: land subsidence, biodiversity loss, and water systems historically designed for drainage rather than retention. Climate change will intensify both drought and flooding.

Landscape office ZUS has proposed a future vision for Midden-Delfland as a productive and climate-adaptive landscape: a water-retention "sponge" for surrounding cities, combined with forestry, innovative agriculture, improved biodiversity, and greater public accessibility (see figure 3). This studio takes that vision as a starting point. *This studio, Ecologies of Inclusion, asks how housing can contribute to both ecological resilience and social accessibility within this context.*

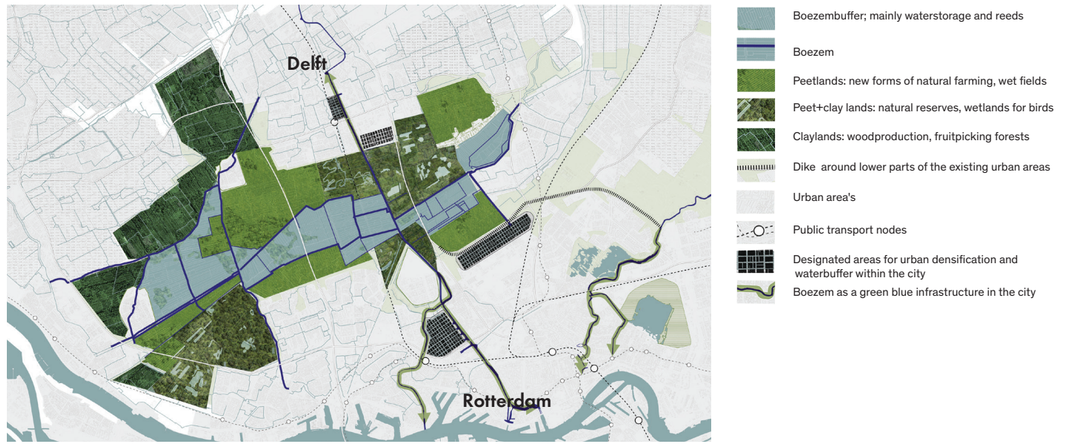


Figure 3. Vision for National Productive Park Delfland, *Zones Urbaines Sensibles*

Figure 4. Bijzonder Provinciaal Landschap Midden Delfland and connecting green areas

1. Problem Statement

Mono-Functional Industrial Sites as Opportunity

In response, our group identified mono-functional industrial areas at the urban–polder edge as strategic sites for transformation (see figure 5 & 6). *These areas are already urbanised, serviced, and well connected, yet are often considered undesirable places to live.* Many consist of business parks or industrial estates with very little architectural quality and inefficient, low-density land use.

We argue that these sites can be re-imagined to accommodate new housing while retaining productive functions. By intensifying already developed land, they can reduce pressure on surrounding landscapes and avoid further greenfield expansion.

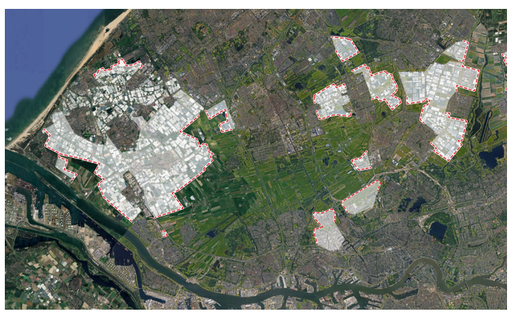


Figure 5. Industrial sites, warehousing, and greenhouses between urban and greenfield land

- Good housing: is well-connected, close to nature, close to amenities
- Inclusive = Affordable: cheap land, creative policy opportunities
- Sustainable: let's use existing infrastructure, no greenfield sites!

- mono-functional industrial land
- well-connected
- at the edge between city and nature

Figure 6. How the studio topics led to the site choice

1. Problem Statement

Design Challenges

However, introducing housing into industrial areas raises critical challenges. How can productive functions be retained without being displaced by rising land values? How can housing remain affordable rather than becoming speculative real estate? How can conflicts of noise, safety, logistics, and privacy between living and working be resolved? And how can such areas become socially sustainable, pleasant, and genuinely desirable places to live? *Despite their strategic potential, these sites remain severely underexplored architecturally.*

Thesis Position

This project investigates how mono-functional industrial land at the urban edge can be transformed into a mixed-use neighbourhood that combines housing, work, and landscape systems (see figure 7). It explores whether compact, low-carbon, and socially inclusive housing can coexist with productive and commercial activity, and whether such a model could offer a scalable response to the Dutch housing crisis within environmental limits.

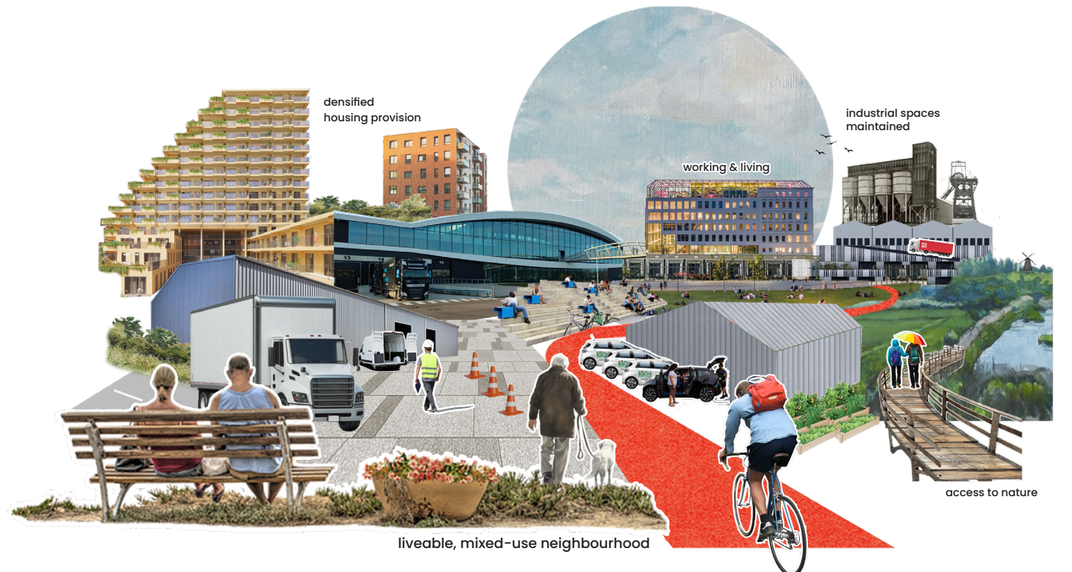


Figure 7. Vision for a mixed use Rodenrijs Polder

2. Relevance

Urgent challenges

This project addresses two urgent and interconnected challenges: the climate crisis and the housing crisis. While international agreements such as the Paris Agreement call for rapid reductions in carbon emissions, the built environment remains a major contributor through construction and energy use. At the same time, *the Netherlands aims to deliver 900,000 new homes by 2030* (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2022), but land scarcity and rising costs make this increasingly difficult. These challenges require not only policy responses, but new architectural models that use land, materials, and energy more intelligently.

Architectural knowledge

Industrial and business areas are an underused resource for future housing, but their potential is underexplored in terms of typology, comfort, and everyday liveability. By testing how such sites can become mixed-use neighbourhoods with attractive low-carbon housing, this could become a transferable model for future development.

The project aims to show that sustainable and affordable housing can also offer spatial generosity, dignity, and architectural quality.

3. Objective & Motivation

Why this topic?

I have always been interested in architecture as a social and environmental tool rather than as a formal or aesthetic exercise. I am drawn to address housing need and environmental protection at a systemic scale (policy, planning), however I also believe that *beautiful, carefully designed buildigns nad public spaces have the power to expand our imaginations*, and open the door to broader change at the urban and policy scale.

Housing is the foundation of a healthy society, and everyone should have access to adequate, affordable, and dignified homes. The need to build more housing while drastically reducing emissions creates a fundamental challenge, and I am motivated to find practical and transferable solutions that shake up our preconceptions of housing, and make intelligent use of existing ideas and technologies.

Architectural & technical ambitions

- Transform a conventional business park into a desirable mixed-use neighbourhood where people genuinely want to live.
- Create compact apartments and shared spaces that feel generous, pleasant, and foster community.
- Integrate principles of low-carbon construction, adaptable structures, and low-energy living.

4. Research & Design Questions

Radical Sharing

Based on the problem statement and our identification of mono-functional industrial sites as opportunities for housing, this project is structured around three overlapping themes. Together, they form the central concept of Radical Sharing: the intentional sharing of land, infrastructure, domestic space, resources, and social amenities to create greater ecological, social, and spatial value with fewer private resources.

3 themes

1. Densified, mixed-use neighbourhood

How land and infrastructure can be shared: by combining housing, work, and amenities on one site. How living and production can coexist through proximity and mutual benefit.

2. Redefined comfort standards

How smaller private homes and generous shared spaces can maintain quality of life while reducing cost, material use, and energy demand, questioning the conventional maximising of private floor area.

3. Living together

How sharing facilities, daily routines, and support networks can strengthen community, improve wellbeing, and reduce isolation. Sharing in a housing context also has huge social benefits.

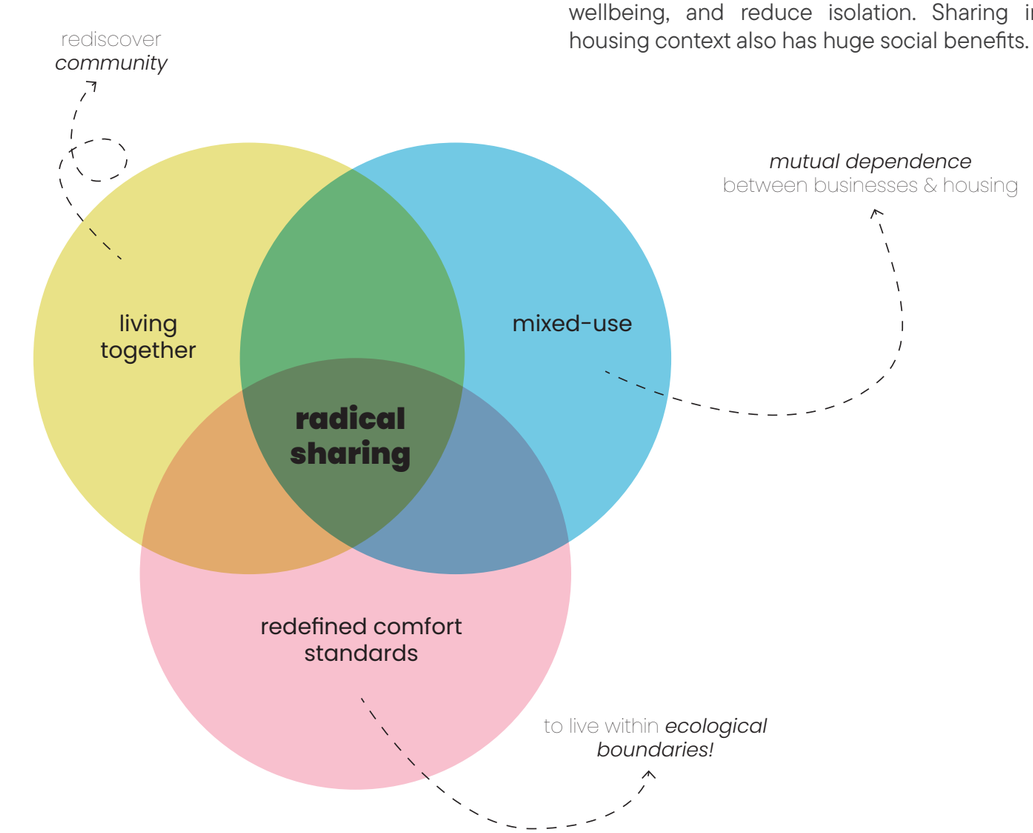


Figure 9. This project in one diagram!

4. Research & Design Questions

Research Question

How can the concept of radical sharing transform mono-functional industrial sites into mixed-use neighbourhoods with affordable, low-carbon, and desirable housing?

Sub Questions

1. Densified, mixed-use neighbourhood

How can housing and productive activities be successfully integrated on existing industrial land?

2. Redefined comfort standards

How can architectural design redefine comfort to reduce spatial, material, and energy consumption without reducing perceived quality of life?

3. Living together

How can shared living models strengthen community while supporting affordability and ecological goals?

Design Questions

- How can housing be introduced into industrial areas without displacing productive functions?
- How can affordable housing maintain architectural quality and liveability?
- How can compact homes with extensive shared facilities become desirable to a broad public?

5. Scope

Location

The site is lcoated to the east of the Rodenrjs metro station, across the N471 road, on the Oudeland Bedrijvenpark (business park). Within this site, my buidling project will take place on the northern parking area next to the business quarters of FOX Global Logistics.

Programme

- A building complex and its surrounding public spaces
- An active plinth with, for example: co-working spaces, commercials or leisure uses, business spaces for the neighbouring shed
- A parking system for both residents and re-providing the parking spaces lost on site, also including bike parking and shared mobility
- 2-3 housing communities of 20-50 units
- Private, shared, and public outdoor spaces
- A catalogue of shared spaces for residents, for example: laundry, cooking, meeting.

Figure 10. Masterplan site location within Midden Delfland

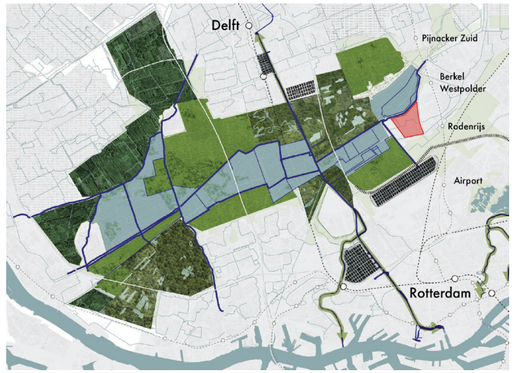


Figure 11. Masterplan site location within the vision of ZUS landscape architects

Figure 13. Masterplan Site Location

Figure 12. Buidling Site Location

Site visit photo, by Denise Heidema

Part 2

Approach

1. Methods

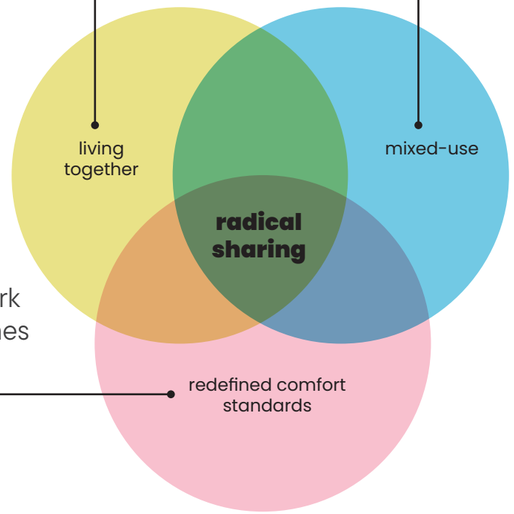
2. Theoretical Framework

A. Mixed-Use and Tabular Scripta

B. Affordable and Collaborative Living

C. Living Small

The 3 parts of the theoretical framework are organised according to the 3 themes running through my project.



1. Methods

The “adjacent possible”

This approach focuses on creating innovation through new combinations of ideas, techniques, and models that already exist and are feasible today. Rather than inventing entirely new systems, the project assembles and adapts proven spatial, social, and technical strategies to the specific context of mono-functional industrial sites on the Dutch urban edge.

Literature

A broad literature review was carried out, particularly in the first quarter, focusing on affordability, collective living, mixed-use development, and low-carbon housing. Sources included academic articles, policy reports, architectural manifestos, and books. This informed the framework and ambitions of the project.

Case studies

Case studies were analysed at every step of the way,a nd for every major design decision. Historical and contemporary examples were studied to understand existing approaches to compact living, shared housing, mixed-use typologies, circulation systems, material strategies, and adaptable building forms, etc.. They were compared and used to test design decisions in a quick way.

Research by design

The main method was research by design: an iterative process in which proposals were developed, tested, evaluated, and refined through drawing, modelling, whole zooming in and out of scales.

1. Methods

Model making

Physical model making supported this process. Site models at 1:500 and 1:200 were used to test massing, spatial relationships, and the project’s response to the industrial and landscape context. A larger 1:50 fragment model was used to study the atmosphere and spatial quality of the winter garden.

Field work

We visited the site to understand its current atmosphere, scale, and relationship to the surrounding polder landscape. I also organised a call with a business developer at FOX Global Logistics to better understand the needs and perspective of the business on site.

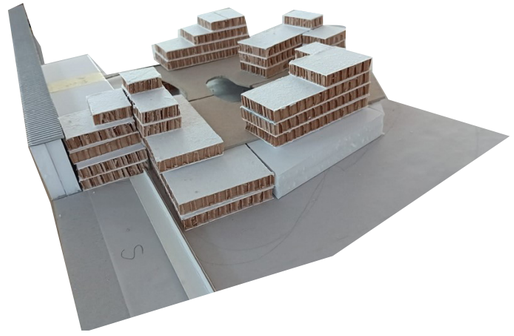


Figure 14. 1:200 sketch massing model

Figure 15. Photo from site visit: the lake, the industry, and Rotterdam skyline in the background. Denise Heidema.

2. Theoretical Framework

A. Mixed-Use and Tabula Scripta

This section outlines the research and references that informed our response to the site. It focuses on productive mixed-use urbanism and architectural approaches that work with what already exists.

A good city has industry

The 2016 BOZAR exhibition A Good City Has Industry argued that production is essential to a healthy and sustainable city. It challenged the common separation of housing and industry, where productive activities are pushed to the urban edge.

Keeping industry in cities supports employment, shortens supply chains, and strengthens circular economies. It also promotes social diversity by providing jobs beyond the service sector. For this project, it reinforced the idea that industry should remain part of urban life.

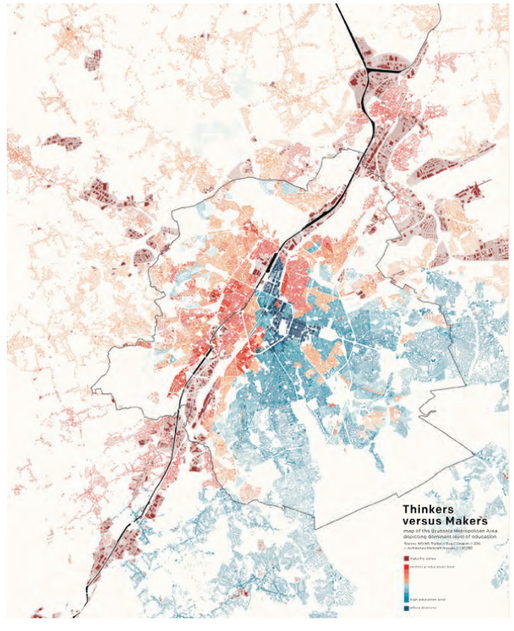


Figure 16. Thinkers vs. Makers: dominant level of education in Brussels, by Architecture Workroom Brussels

Figure 17. Photographs from the exhibition, A Good City has indsutry

Mixed-Use City

Many planners and researchers promote mixed-use development as a more efficient and resilient urban model. Combining housing, work, and services can reduce commuting, intensify land use, and create more active neighbourhoods.

In the Netherlands, the College van Rijksadviseurs developed the Metro Mix principles, which explore different ways of combining living and working, from business districts to productive mixed neighbourhoods. Their key message is that cities should move beyond strict zoning.

This principle is also described as co-location: placing production, workspaces, and housing close together. Research shows this can help retain urban manufacturing, reduce transport, and encourage collaboration, if carefully designed.

Architectural research has also explored how buildings can enable mixed use. The Superplinten handbook for Sloterdijk Zuid shows how active, deep plinths can host workshops, amenities, small businesses, and public functions, with housing or offices above. The plinth acts as a link between public life and productive activity.

Case studies helped inform our masterplan design. NovaCity in Brussels combines productive ground floors with housing above. Wick Lane by dRMM in London mixes residential and workspace uses in a timber building. Both show how dense urban blocks can successfully combine living and working.

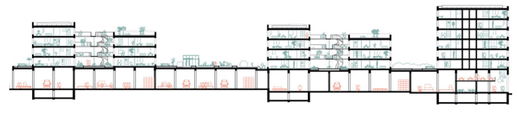


Figure 18. Indsutry and Housing in Novacity, Brussels, by DDS+

Figure 20. Wick Lane, by DRMM

Figure 19. Superplinten, Metro Mix

2. Theoretical Framework

A. Mixed-Use and Tabula Scripta

Greener Warehousing

Warehousing and logistics occupy large areas but are often mono-functional and spatially poor. New approaches aim to make these necessary buildings denser, greener, and more integrated into the city.

The INIT Building in Amsterdam is an example of a large work building that also contributes to urban life through active ground floors, amenities, and public presence. It shows that productive buildings can add value beyond their economic function, and become more urban, mixed, and socially useful.

Figure 21. Not your average warehouse. INIT, Amsterdam.

2. Theoretical Framework

A. Mixed-Use and Tabula Scripta

Tabula scripta

Tabula scripta, developed through the research of the Amsterdam Academy of Architecture (2014–2019), proposes designing through reading and adapting what already exists on a site, rather than clearing it for new development. Rather than clearing sites for new development, this approach sees the existing city as a resource: buildings, uses, infrastructures, and histories. It reduces waste and carbon emissions, but also preserves spatial qualities and local identity. In this project, it supports retaining industrial structures and adapting them over time.

Figure 23. Alkemade, Iersel and Oudburg (2020) Rewriting Architecture – 10+1 Actions

Never Demolish

Lacaton & Vassal's work is hugely influential to me. Their well-known transformations of social housing estates in France demonstrate how careful additions, winter gardens, balconies, and spatial upgrades can radically improve living quality without demolition.

Their principle of "never demolish" has environmental, economic, and social value. It saves embodied carbon, reduces cost, and allows communities to remain in place. Their work demonstrates that transformation can be more generous and intelligent than replacement.

Figure 22. Still from the youtube video: Lacaton & Vassal: Life and works, by T. Hasan

2. Theoretical Framework

B. Affordable and Collaborative Living

This section explores how housing can remain accessible through different forms of ownership, governance, and shared living, and reviews the alternative housing models that informed the project.

Status Quo & Affordability Crisis

Rising land values and housing shortages have made secure housing increasingly difficult, especially for young people and middle-income households (McKee, 2012). Housing affordability is shaped by both spatial and institutional factors (FigureXX), including land scarcity, location, infrastructure, construction costs, planning policy, taxation, mortgage systems, rent regulation, and investment markets.

Especially in cities, housing increasingly functions as an investment asset rather than a social good. Rising prices make ownership difficult, while private rents have also become less accessible. Many households face long waiting lists, high rents, or dependence on family wealth to buy. McKee (2012) notes that prolonged inability to access homeownership can harm wellbeing, security, and future planning. This reinforced the importance of affordable rental housing as both a stable option and a stepping stone.

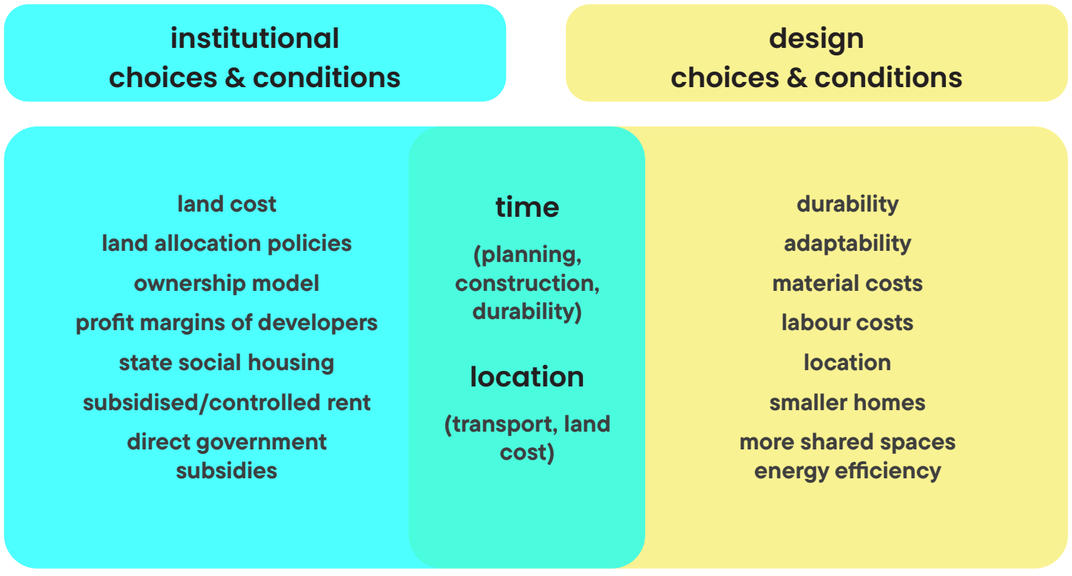


Figure 24. Factors for housing affordability

2. Theoretical Framework

B. Affordable and Collaborative Living

Defining Affordable Housing

Affordable housing is commonly defined as housing costs below 30% of gross household income, including rent or mortgage payments, maintenance, and taxes (Nelson, 2018). Other definitions are market-based: in England, for example, affordable rent can mean up to 80% of local market rent, while social rent is around 50%.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Young People, Homeownership and Future Welfare

Kim McKee

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Affordability through design: the role of building costs in collaborative housing

Sara Lia Brysch & Darinka Czischke

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Collaborative Living as a Solution

Collaborative living is not new, but it has regained attention in recent years. According to Darinka Czischke in the book Together: Towards Collaborative Living (2023), people choose collaborative housing for three reasons: affordability, stronger community, and lower environmental impact.

Research also highlights both social and economic benefits of collaborative housing. Shared facilities, resident participation, and efficient design can reduce costs and create social value.

"The community realm gives us the opportunity to lead more fulfilling personal lives by cooperating with thirty, forty or fifty adults - a scale at which so much more can be accomplished for some of our life's needs than at the private or public scale."

McCamant & Durrett (2011, p.253)

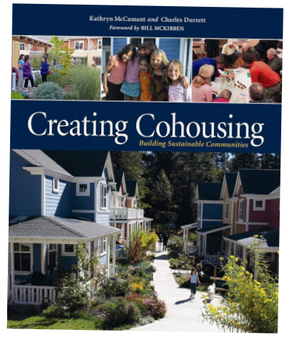


Figure 25. Together: towards collaborative living (Czischke et al., 2023)

2. Theoretical Framework
B. Affordable and Collaborative Living

This spread gives an overview of the studied options to establish collaborative housing.

CPOs in the Netherlands

The Netherlands has a tradition of collective living, including Centraal Wonen communities and resident-led projects. Many examples are organised as CPOs (Collectief Particulier Opdrachtgeverschap), in which future residents jointly commission and develop their housing.

CPOs give residents more control over design, layout, and community structure. However, they also require time, financial capacity, and organisational effort. This means they can be empowering, but are not easily accessible to everyone.

Housing Cooperatives

Housing cooperatives are non-profit housing organisations owned and governed collectively by members. Residents do not speculate on property value, but gain secure and affordable access through membership or shares.

They are especially successful in Switzerland: 19% of housing in Zurich are non-profit cooperatives (Boudet, 2017, p.375). Their success is linked to long-term public support, access to land, and favourable financing (Balmer & Gerber, 2018). Cooperative housing often delivers affordability, stability, and strong communal identity (Sascha, Hehl & Ventura 2020)

In the Netherlands, cooperatives remain limited due to a dominant housing association sector, high land prices, and limited legal or financial support for new cooperatives.

Figure 26. D. Sascha, R. Hehl, P. Ventura (2020). Housing the Coop: A Micro-Political Manifesto.

2. Theoretical Framework
B. Affordable and Collaborative Living

Community Land Trusts

Community Land Trusts (CLTs) are democratic, non-profit organisations that own land for community benefit. They typically develop affordable housing, but may also include shops, energy projects, or food initiatives.

A key principle is the separation of land and building ownership: the trust retains the land, while homes are rented or sold under resale conditions that preserve affordability. CLTs emerged in the United States in the 1960s and have expanded in Europe, especially in the UK, Belgium, and France.

Municipal support is often essential for land provision, recognition, or financing. In the Netherlands, CLTs are still emerging but gaining interest.

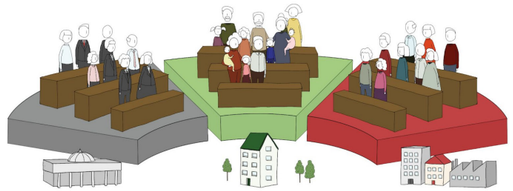


Figure 27. Diagram of tri-party governance of Community Land Trusts. Source: CLT Brussel with Monica Gallab

Stichting And The People is a Dutch social impact organisation promoting the CLT model in the Netherlands, where CLTs are not yet formally recognised in law or policy. The organisation produces research, advises municipalities, and supports pilot projects that enable residents to collectively shape neighbourhood development.

One key example is CLT H-Buurt in Amsterdam Zuidoost, widely seen as the first CLT pilot in the Netherlands. And The People supported its organisation, community engagement, and development process.

And The People

Community Land Trust H-BUURT

Partnerships

Other models combine residents, municipalities, housing associations, and private or non-profit actors. These partnerships can create solutions that no single actor could deliver alone.

The Knarrenhof Delft project is one example. A citizen initiative for senior co-housing was realised through collaboration between residents, the Knarrenhof foundation, the Municipality of Delft, and housing association Vidomes. This allowed a socially inclusive and community-led project within a complex urban redevelopment site.

Such partnerships are important in the Dutch context, where new cooperative models are still developing. They show how innovative alliances can already deliver more affordable and socially valuable housing.

Knarrenhof Foundation
non-profit developer

Gemeente Delft
Municipality

Trekkersgroep
Future residents and motivated citizens

Vidomes
Housing Assosciation

Figure 28. Residents in the Zutphen Knarrenhof. Source: ONS Magazine

Why Live Smaller?

In Small Is Necessary (2018), Anitra Nelson puts it simply: we need to live smaller and share more. Reduced private floor area combined with generous shared spaces can lower housing costs, material use, and energy demand.

This responds to a wider problem: homes are getting larger while households are getting smaller. This increases both construction materials, and the energy for heating these homes.

> *"As households get smaller worldwide, the extent of sharing within households reduces, resulting in rising per capita energy use and greenhouse gas (GHG) emissions. We find that one-person households are most carbon- and energy-intensive per capita."*
> Ivanova & Busch (2020)

Housing needs to change, and part of that learning to live smaller.

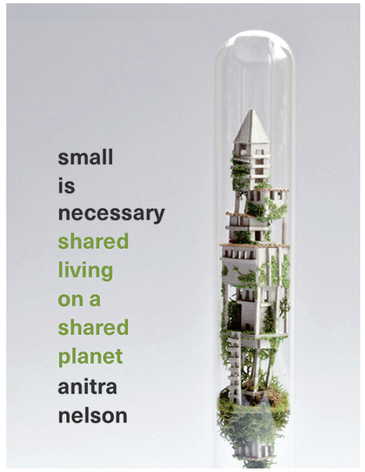


Figure 29. Nelson (2018) small is necessary

"only 5% of EU households live within climate targets"
(Ivanova & Wood 2020)

Target footprint: **< 2.5 t** CO_2eq/cap
(Ivanova & Wood 2020)

Dutch footprint: **13.5 t** CO_2eq/cap
(CBS, 2022)

2. Theoretical Framework
C. Living Small

History of Minimum Dwellings

Historically, minimum dwellings have represented hardship, but also innovation. The idea of *Existenzminimum* emerged after World War I, when housing shortages forced architects to rethink how much space was needed for healthy living. Modernists within CIAM studied minimum standards for light, air, hygiene, and efficiency. In the hope that good living conditions could be provided to the largest number of people.

At the same time, Soviet experiments explored more radical collective housing with shared kitchens, laundries, childcare, and social spaces. Projects such as the Narkomfin Building reframed the dwelling as a "cell within a larger social organism, but designs that were too communal proved unpopular, people often adapted their spaces to regain privacy and autonomy.

Figure 30. Teige, K. (2002). The minimum dwelling.

What can be shared?

Many spaces in housing are already shared, such as gardens, corridors, laundries, bike storage, and sometimes kitchens or bathrooms. The diagram below shows that in general, people are more comfortable sharing unheated spaces than private interiors. The most intimate space remains the bedroom.

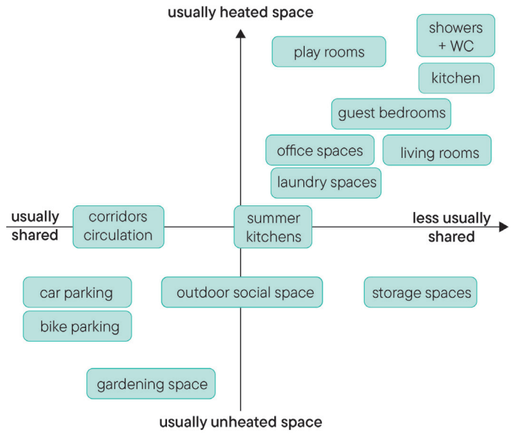


Figure 31. What can be shared? Brainstorm.

See Appendix E for case studies of minimum dwellings and contemporary collective living

Rethinking Domestic Comfort: Beyond Smaller Homes

Reducing cost and environmental impact is not only a question of reducing square metres: how spaces are shared, how often rooms are actually used, how buildings are heated all have a big impact.

In her thesis, Sarah Brysch (2021) reinterprets the concept of Existenzminimum. She critiques contemporary micro-apartments that minimise private space without improving collective life, often resulting in isolation and poor living quality. She argues that *compact living should be compensated through generous shared spaces, adaptable domestic arrangements, and stronger social infrastructures.*

Brysch also reframes comfort standards as culturally constructed rather than fixed. Contemporary housing often assumes that every household needs permanently heated private rooms, private appliances, guest rooms, workspaces, and storage, regardless of how infrequently they are used. *By reducing "duplication" of spaces through sharing, we can lower both environmental impact and housing costs while maintaining quality of life.*

These ideas were decisive in framing the leading idea of this thesis: Radical Sharing.

Figure 32. Towards a new Existenzminimum: Defining principles for the co-design of affordable collaborative housing. (Brysch, 2024)

2. Theoretical Framework
C. Living Small

Radical, Elitist, or Inclusive?

Historically, small living was associated with the masses. Today, this concept is assosciated with profit-driven developers who build compact homes to maximise profit.

Alternative small-living models such as the Tiny House movement, and other ecologically-motivated collaborative housing are gaining popularity in the context of the housing crisis and against consumer culture. But these projects and ideas remain exceptions rather than mainstream models. They attract people that have the time, money, or motivation to organise together and live unconventionally.

Rogers' Innovation Adoption Curve (figure 33) is a useful lens to understand how new ideas spread in society. I wanted to avoid designing only for pioneers or idealists. This helped me define my target group as early adopters or majority, ie. mainstream households. *I aim to make compact living practical and desirable.*

Figure 33. Iewan, Nijmegen. In collaboration with ORIO Architecten

Iewan is an ecological, wood and straw collective housing project that celebrates compact living alongside many shared facilities: a luxury bathroom, shared cars, guest rooms, washing rooms.

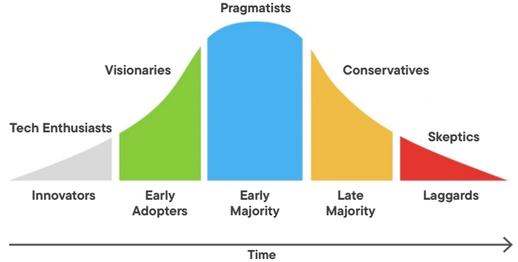


Figure 34. Roger's Innovation Adoption Curve

Kvarteret Trevnaden cohousing, Sweden. Photo from: Czischke et al. (2023)

Part 3

Results

1. Masterplan
A. Site Analysis

Rodenrijs Polder is a historic polder (droogmakerij) on the edge of Midden-Delfland, surrounded by a boezem (high water infrastructure). *20 years ago it was still largely greenfield with a few greenhouses.* Since 2019 it has rapidly developed into an industrial zone, now organised as Bedrijvenpark Oudeland with around 250 businesses (figure 35).

The site is highly mono-functional, dominated by large logistics warehouses, car-related services, and other multi-tenant units (signage, design, catering, wholesale). *The scale contrast is extreme, with some warehouses reaching up to 300 metres in length.*

The site is separated from Berkel en Rodenrijs by the N471. Housing exists only at the edges, with detached homes along the southern and western boezem, and larger residential areas further east beyond the railway.

Despite this, the site is well connected. Cycling and pedestrian routes link it to Midden-Delfland and Berkel en Rodenrijs. *The Rodenrijs metro station (line E) is 10 minutes by bike from the furthest point of the site, and takes 9 minutes to reach Rotterdam Centraal.* From the centre of the site, it is a 15–20 minute walk to the metro.

To the west, cycle routes lead into Midden-Delfland, passing the historic windmill De Valk. *The site remains embedded in a wider green polder landscape.*

PMBO
STICHTING PARKMANAGEMENT
BEDRIJVENPARK OUDELAND

Figure 35. Logo of the Bedrijvenpark Oudeland Organisation

Figure 36. Rodernijs Polder from 2005 to 2025

1. Masterplan
A. Site Analysis

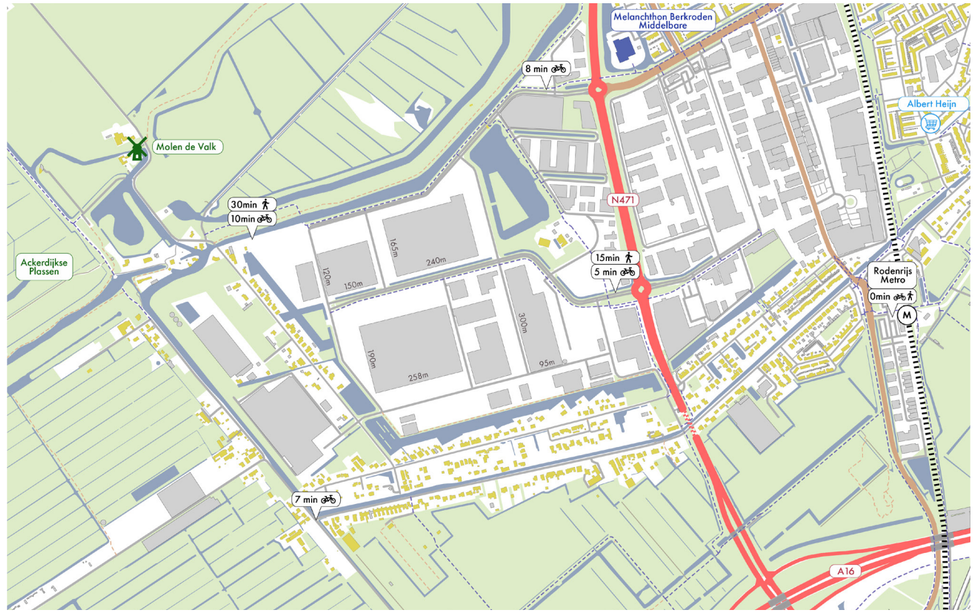


Figure 37. Connectivity around Rodenrijs Polder

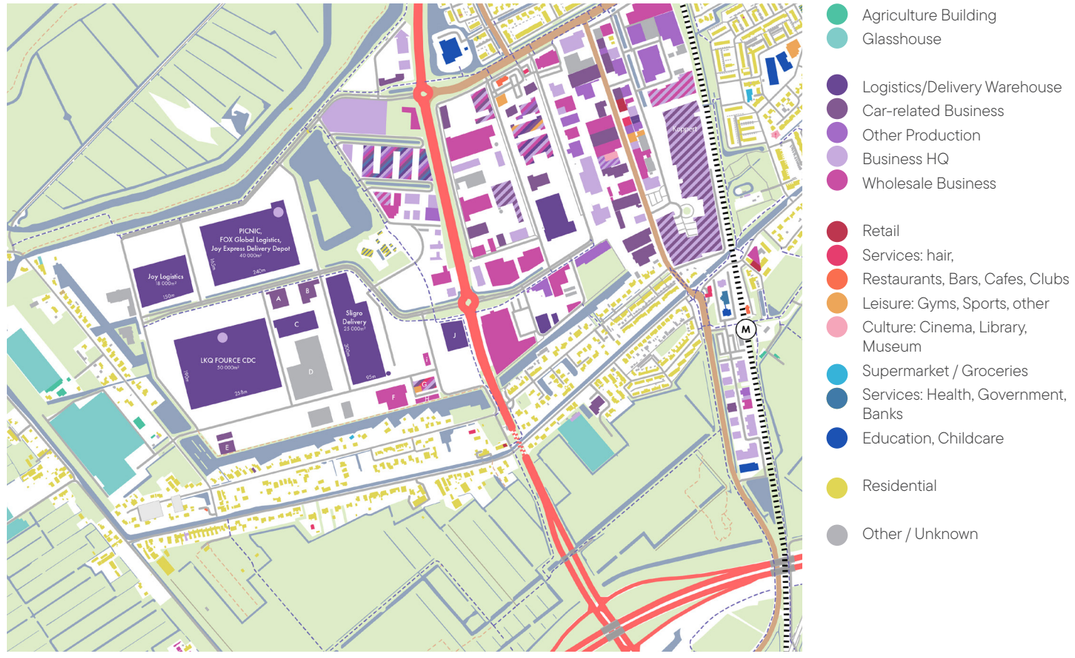


Figure 38. Connectivity around Rodenrijs Polder

1. Masterplan
B. Ambitions

Aims of the Masterplan

From the site analysis, we identified key challenges such as the huge scale of the warehouses, the poor architecture, and lack of public life, and also it's qualities: it is surprisingly walkable, and has pleasant nature. The unused spaces between buildings presented themselves as opportunities. Based on this, we defined six aims for the masterplan.

1. Intensify land use through housing and gradual service integration, creating a denser mixed-use environment over time.
2. Affordable housing is central, enabled by the site's current undervaluation and its potential to host housing models beyond speculative pressure.
3. The existing warehouses, the "exteriorless architecture" is not hidden but reframed and activated, adding orientation, variety, and identity.
4. Support a circular economy through co-location of uses, allowing production, distribution, and consumption to operate in close-by.
5. Make both nature and industry visible, strengthening awareness of ecological systems and normalising industrial presence as part of everyday life.
6. Act as a gateway to Midden-Delfland, offering a place to experience and access the landscape.

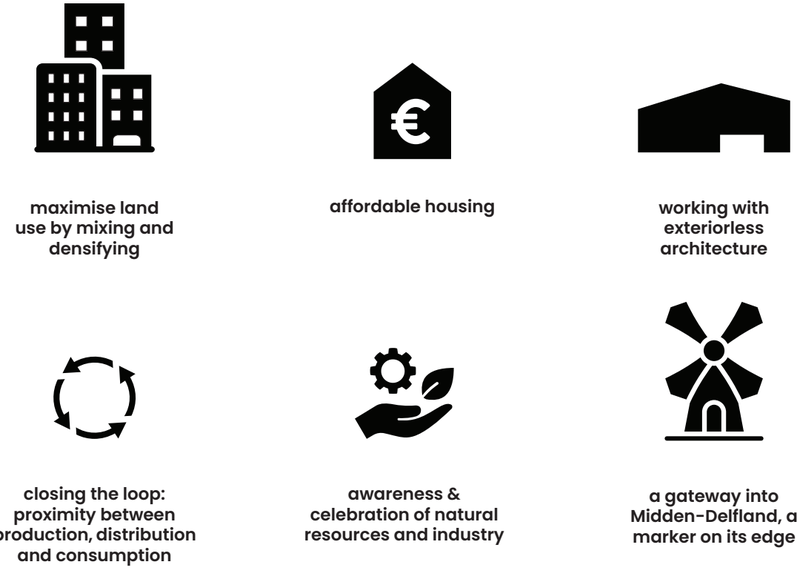


Figure 39. Masterplan ambitions

1. Masterplan
C. Toolbox

Housing and Industry in Symbiosis

The masterplan is based on the idea that *housing and industry should not just coexist, but mutually benefit.* The more interdependent the uses are, the stronger and more resilient the neighbourhood.

Streets & Mobility

Shared streets can follow time-based logic: industrial priority during working hours, slower residential use in evenings and weekends. Shared parking, mobility hubs, and EV charging reduce total parking demand, as workers park by day and residents by night.

Energy & Heat

Waste heat from industry can supply nearby housing. Large warehouse roofs can host solar panels connected to a shared smart grid, balancing daytime industrial demand with evening residential demand.

Water

Rainwater from industrial roofs can be reused locally. Greywater from housing can support cooling or industrial processes.

Space & Facilities

Industrial halls can host workshops, sports, or events outside working hours. Canteens, meeting rooms, childcare, and waste facilities can be shared instead of duplicated.

Shared Governance

A joint management body of businesses and residents can coordinate noise, traffic, public space, and future investments.

See Appendix J for studied examples of innovative indsutrial districts

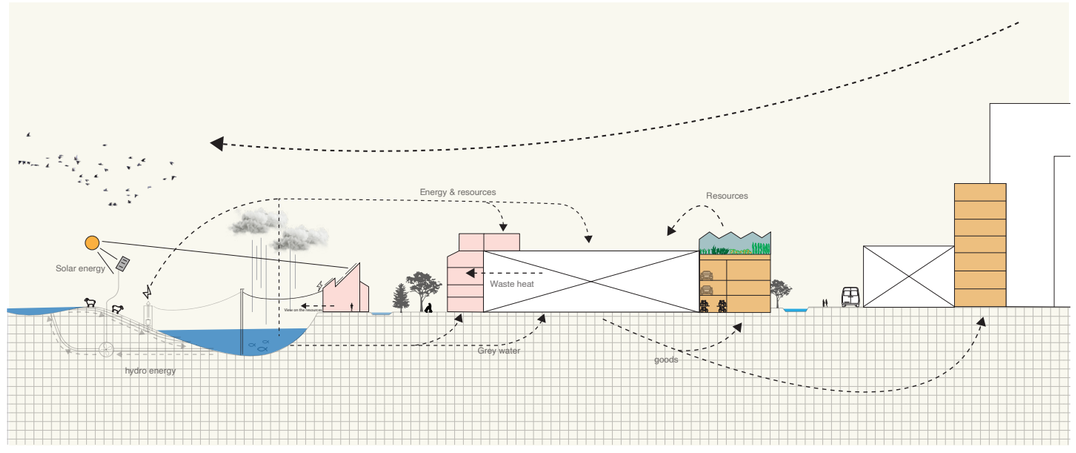


Figure 40. Concept section of exchanges between housing and industry next to the boezem

Creating a toolbox of interventions

Instead of designing a single fixed masterplan, we developed a toolbox of interventions that can be applied incrementally. This responds to the existing warehouse buildings, which we chose to embrace and adapt.

The toolbox (figure 45, next page) ranges from light interventions with minimal disruption to business activities: inserting housing in currently unused spaces, or wrapping the sheds in housing, to more total transformations: adding floors, reprogramming warehouses, or partially removing building segments for new uses. This allows for a gradual transition.

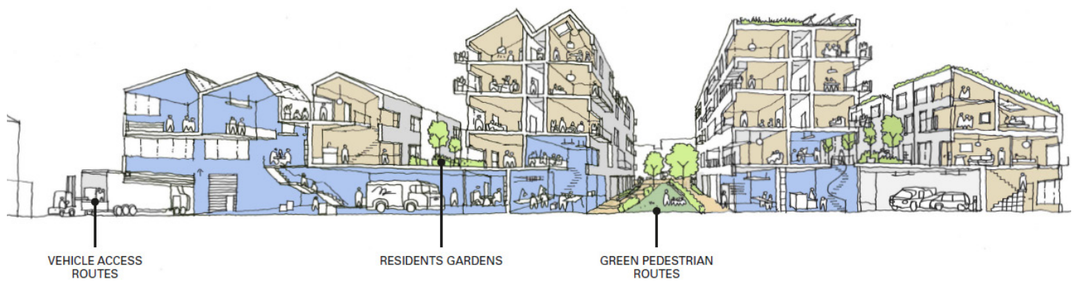


Figure 41. Wick Lane, by DRMM

The group was inspired by the case studies like Wick Lane, with clever layered mixed use architecture, but our a site has many recently built warehouses. *Unlike this example, we couldn't design from a blank slate, we had to think of something else.*

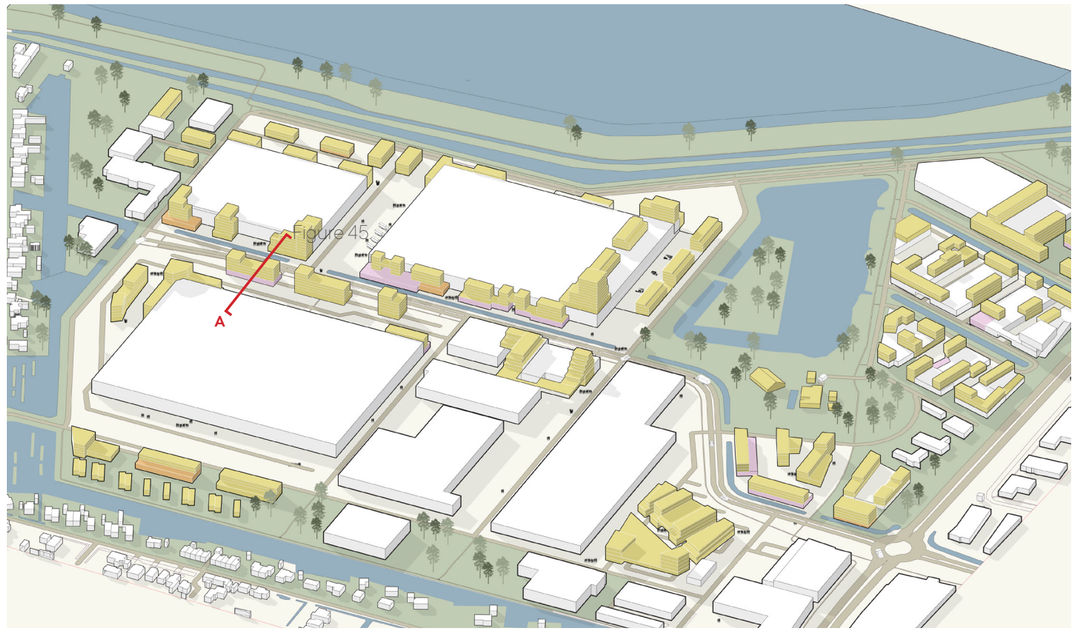


Figure 42. Conceptual Masterplan Massing, different tools from the toolbox applied to the site

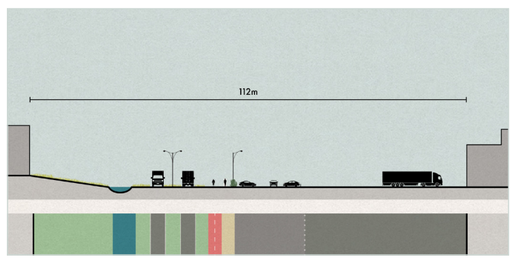


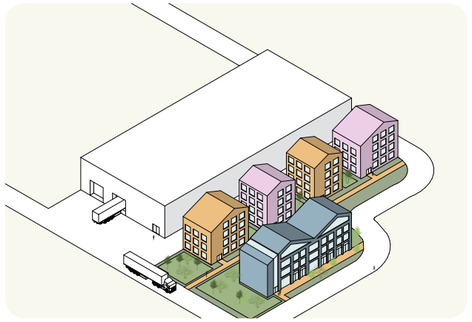
Figure 43. Section A-A & road plan, before

Figure 44. Section A-A & road plan, after

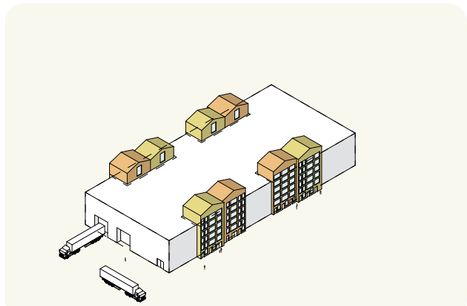
Road sections of over 100 metres in width reveal significant underused space that can be reallocated to public realm, housing, or shared functions while maintaining industrial spaces.

1. Masterplan
C. Toolbox

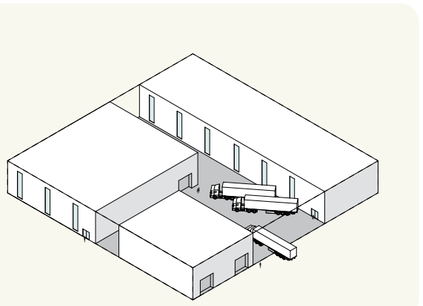
warehouses largely undisturbed — partial or temporary alteration to the structure — warehouses fully transformed



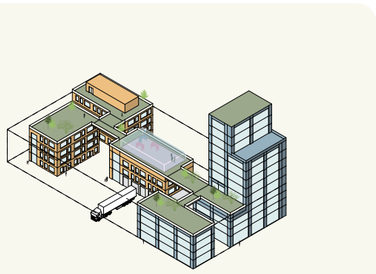
Build on empty plots



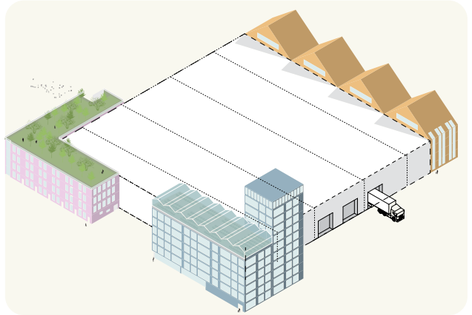
Take a bit out, give it to housing



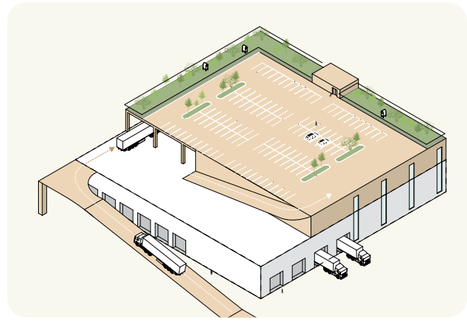
Split up the shed into new configurations



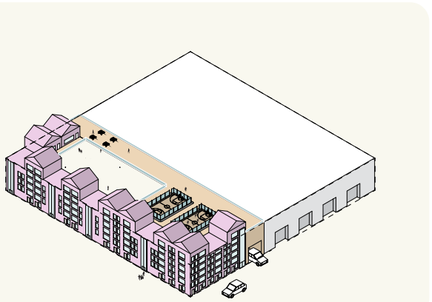
Remove completely and rebuild



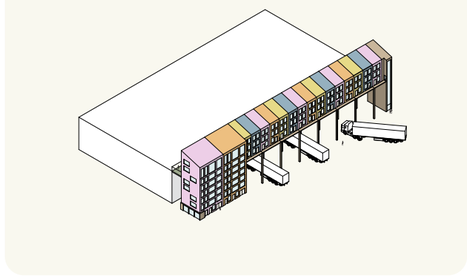
Wrap the sheds



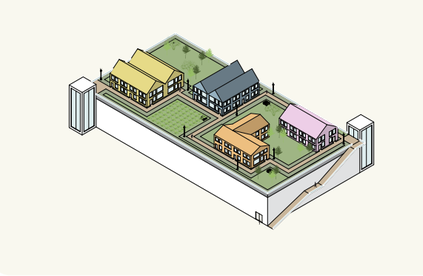
Intensify industry with a second layer



Repurpose a shed into another function



Build over functions



Build on top of part of the shed

Figure 46. Toolbox of mixed-use masterplan interventions

Figure 47. New road hierarchy and cycle and pedestrian routes

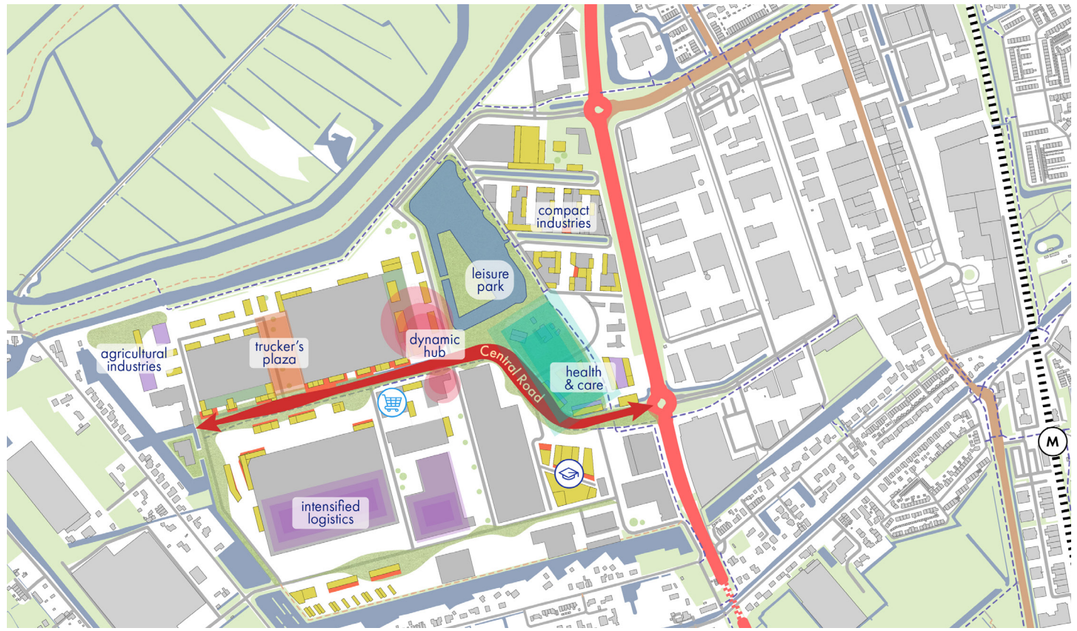


Figure 48. Neighbourhood zones and the central spine

Structuing the masterplan

To organise these interventions, we designed a conceptual spatial structure. Traffic design is mixed-use environments is key, we proposed a road layout that frees up the northern road, along the water buffer (as designed by the ZUS vision), for pedestrians and cyclists. In some side streets, delivery areas a created.

A central spine becomes the main structuring element of the site. This artery combines public transport, logistics access, cycling, and walking. Over time, it can transform into a civic corridor, with public functions such as a supermarket, cultural facilities, and shared services located along it.

We differentiated zones by function: a park and leisure area around the lake, intensified industrial clusters, and areas designated for food production and agricultural industries.

This concept masterplan outlines a long-term transformation of the Rodenrijs Polder into a lively, mixed-use neighbourhood that integrates housing, industry, and landscape, unlocking new connections between residents and businesses.

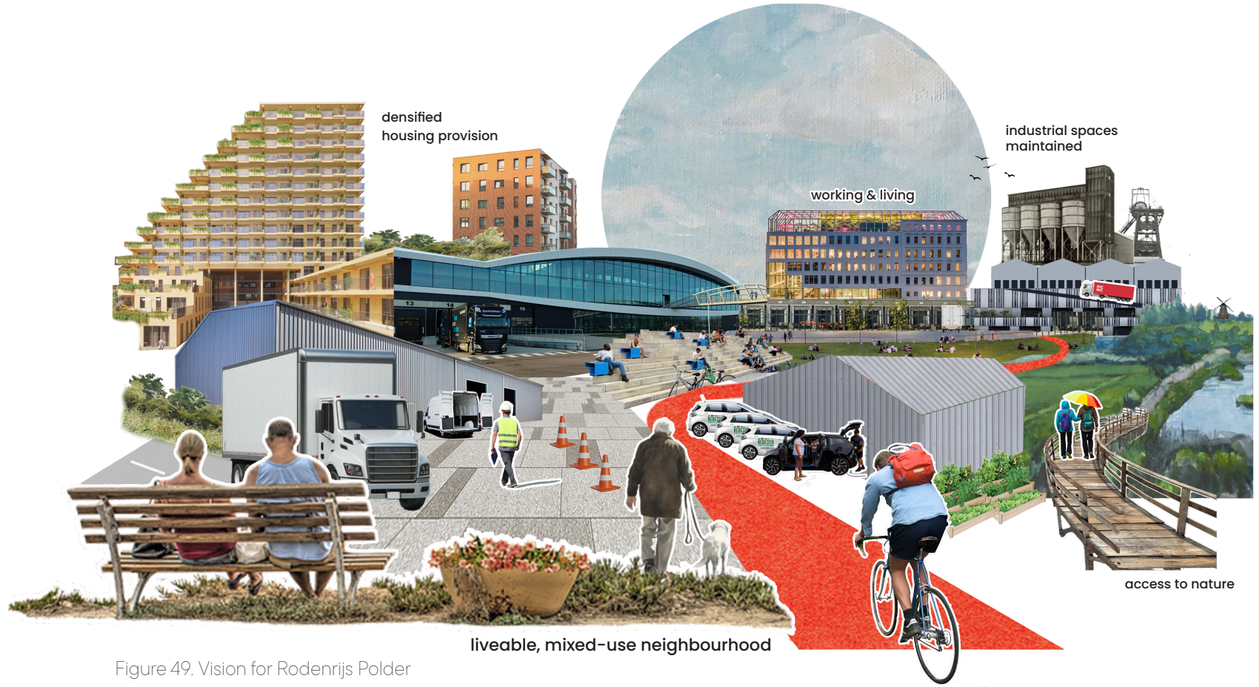


Figure 49. Vision for Rodenrijs Polder

2. Site Analysis

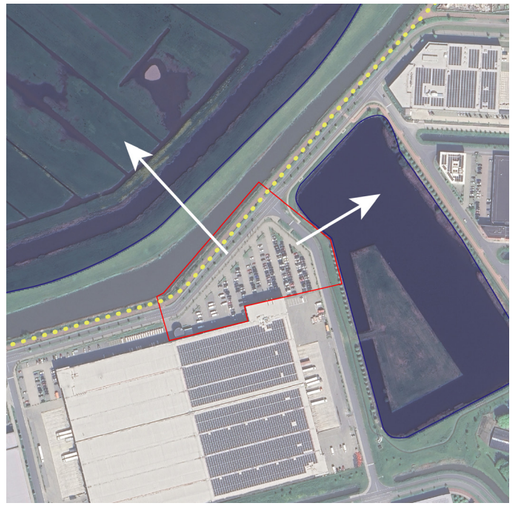
Within the masterplan, I selected the parking area of the large southern warehouse occupied by FOX Global Logistics as the site for my individual design proposal and the testing ground for my research questions.

The site was chosen for its strategic and spatial qualities. It has a prime location next to the future water buffer, lake, and surrounding landscape, yet is currently used as an extensive surface parking lot. Today, it is filled with 263 parking spaces, I'm sure a more efficient and valuable use of the land can be found!

Figure 50. Visualisation of the FOX Global Logistics warehouse and its parking area. *Up project inrichting*

Figure 51. FOX Global from across the lake. January 2026.

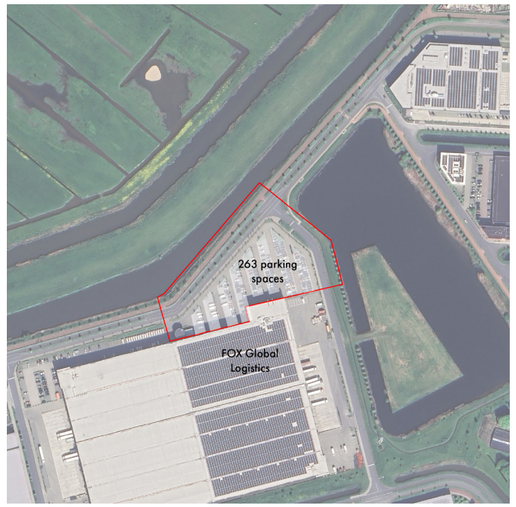
Site Location. North of the masterplan area.



A strategic place next to the cycle lane, polder, and lake.

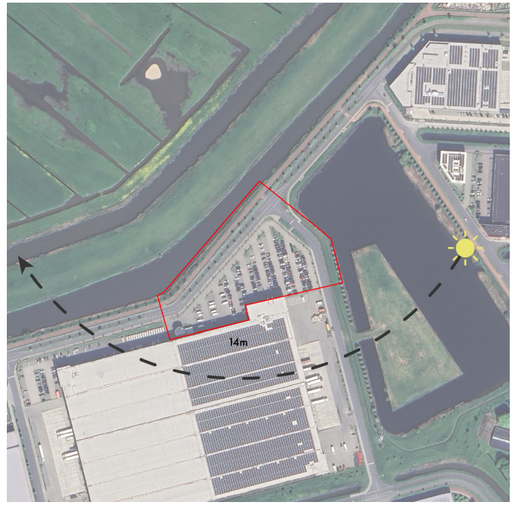
Figure 52. Site analysis

2. Site Analysis

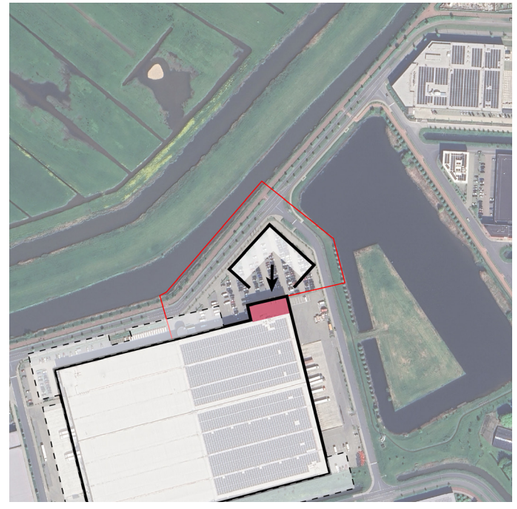


On FOX Global Logistics's 263-space parking lot.

Such a wide road separating from the polder!



The 14m tall warehouse is on the south. This presents daylight challenges.



How will the housing relate to the warehouse?

See Appendix D for further research into FOX Global Logistics, its activities, and a phone interview with one of its business developers.

The opportunity for Affordable Housing on site

The land my site is owned by FOX Global Logistics. The challenge is to formulate a plausible scenario in which this business would want to develop a non-speculative form of housing on site.

Rather than a CLT model, which would require transferring land stewardship, I propose a partnership between FOX Global, Gemeente Lansingerland, a housing association, and resident representatives. Positioned between traditional Dutch social housing and cooperative housing models, this structure allows long-term affordable housing while aligning the interests of public, private, and community actors.

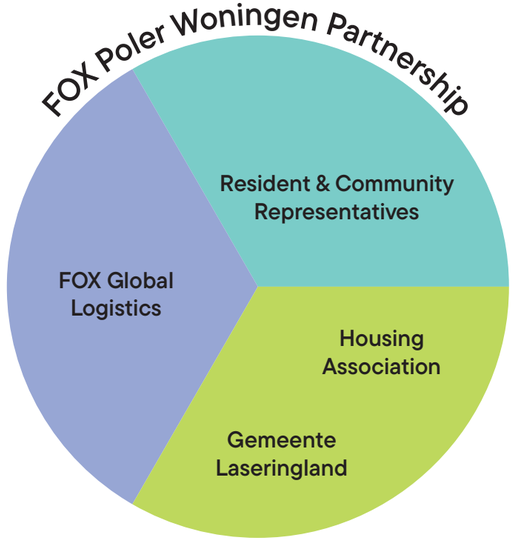


Figure 53. Partnership Diagram

Timeline of actions

1. Municipality permits mixed-use development under certain affordability conditions
2. FOX Global partner with a housing association and initiate development
3. Community engagement gathers project support and involves local represntatives
4. The “FOX Polder Woningen” partnership is established (see figure 52)
5. FOX leases the parking site to the partnership through a long-term land lease (99 years)

Governance is shared equally between FOX Global, public institutions, and residents/community representatives.

Social housing is managed through existing housing association systems, while controlled-rent units generate modest returns reinvested into the site and future affordable housing.

Part of a larger system

The proposal creates long-term links between housing, industry, and local institutions through shared land use, energy systems, and amenities (see figure 53). Existing warehouse roofs with solar panels can support a future local energy community, while shared spaces serve residents, employees, and the surrounding neighbourhood.

3. Spatial & Financial Symbiosis

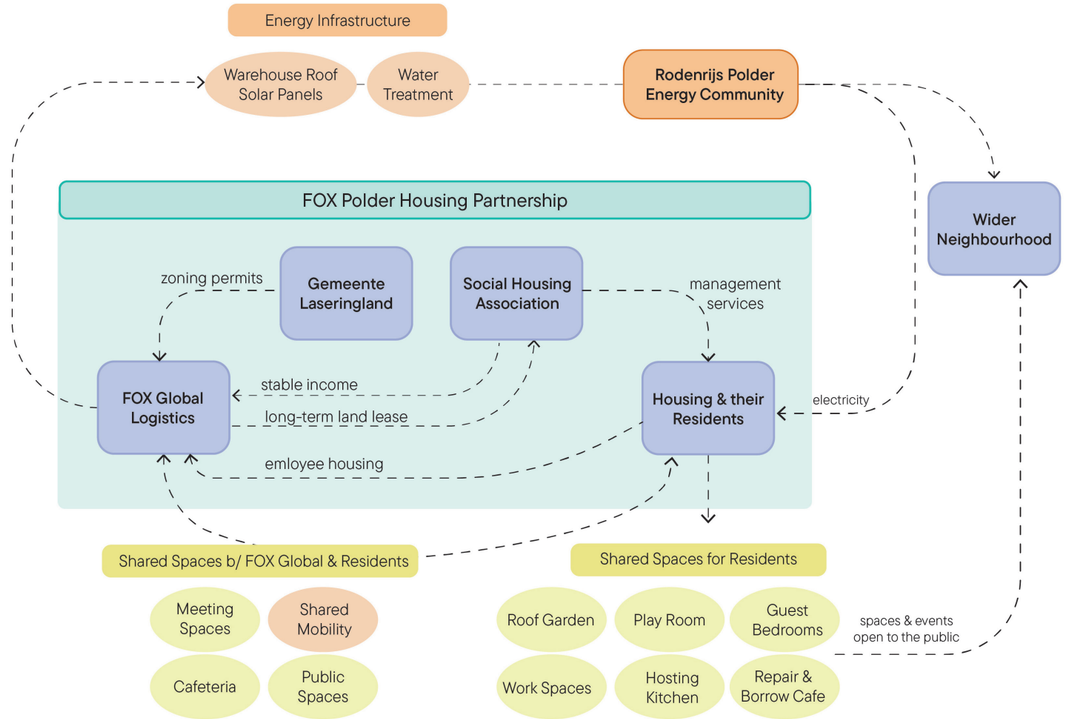


Figure 54. Governance, Ownership, and Flows Diagram

Benefits for each stakeholder

What’s in it for FOX Global?

- Stable long-term income through land lease
- Increased land value and development potential
- Stronger ESG profile and employee environment

Whats in it for Gemeente Laseringland?

- Delivery of affordable housing targets
- Better use of existing urbanised land
- Innovative mixed-use development model

What’s in it for residents?

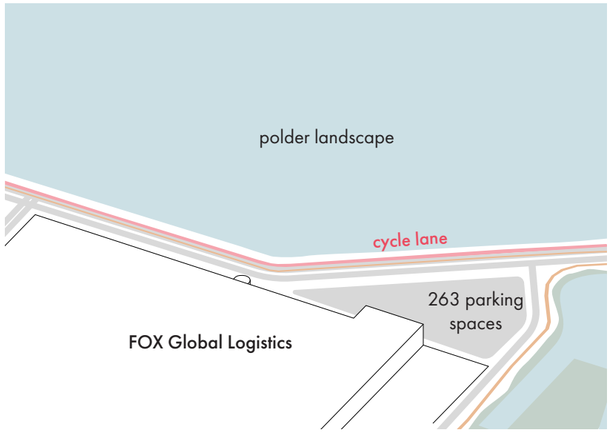
- Affordable, non-speculative housing
- Shared amenities and lower living costs
- Strong community ties
- Proximity to jobs/public transport

What’s in it for the surrounding community?

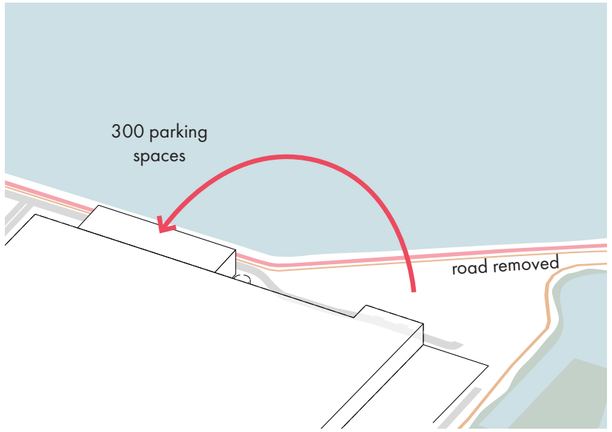
- New public spaces and amenities
- More active and attractive business park environment

4. Form, Functions & Urban Context

A. Form & urban response

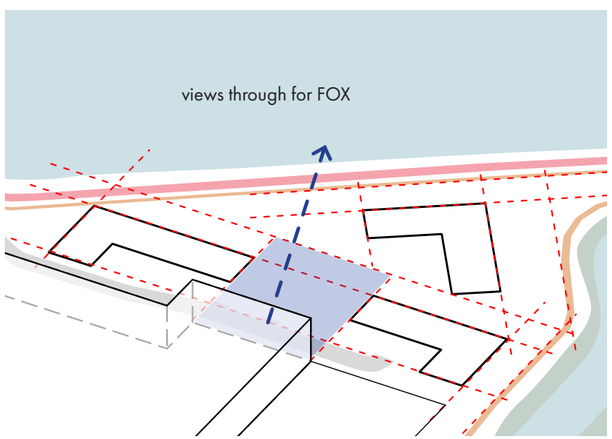


1 Existing Site



2 Parking moved to a multi-storey facility to the west of the site.

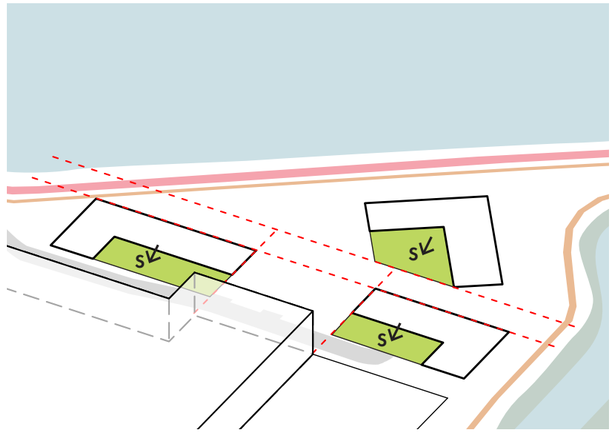
Traffic system is re-arranged to free up the polder edge freed from wide roads.



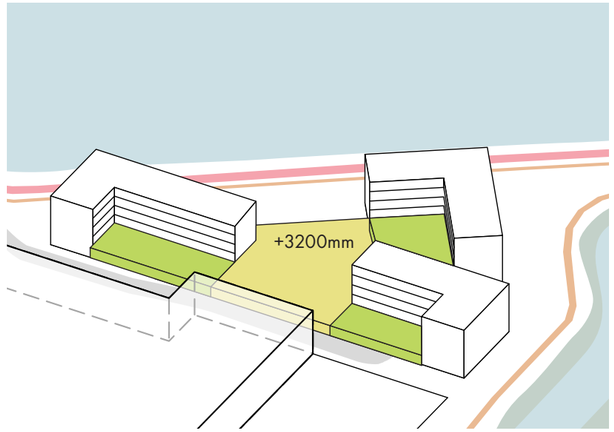
3 There is now space for 3 L-shaped housing blocks. Views are let through for FOX Global.

4. Form, Functions & Urban Context

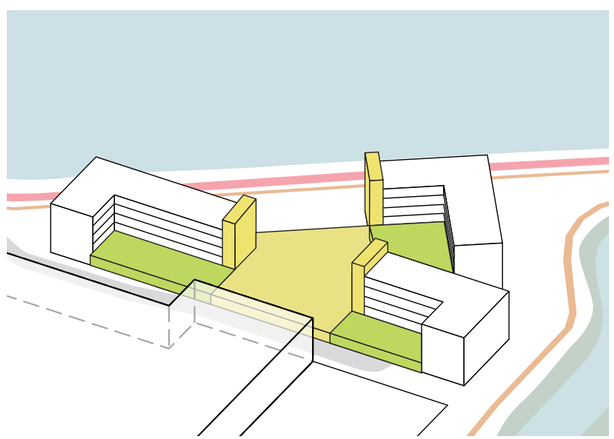
A. Form & urban response



4 Each housing block surrounds a south-facing courtyard.



5 The 3 blocks are connected by an elevated podium, with facilities underneath.



6 Three spines connect the utilities, shared (public) spaces and housing floors.

See Appendix G for form studies and process

4. Form, Functions & Urban Context

A. Form & urban response

Vertical logic

The section follows a clear vertical logic. Parking sits at ground level beneath the podium, with direct delivery access to the workshops and commercial spaces behind. Double-height commercial and productive units have large curtain walls facing the street and entrances opening onto the podium. Some are designed as work-live units, combining a workspace below with a dwelling above.

Height considerations

Three floors of housing sit on top. Elevating the residential levels above the podium brings more sunlight into the apartments. Stopping at three floors keeps the buildings in line with the FOX Global warehouse, and stays within the four-to-five storey limit that research suggests for maintaining a connection between street life and upper floors.

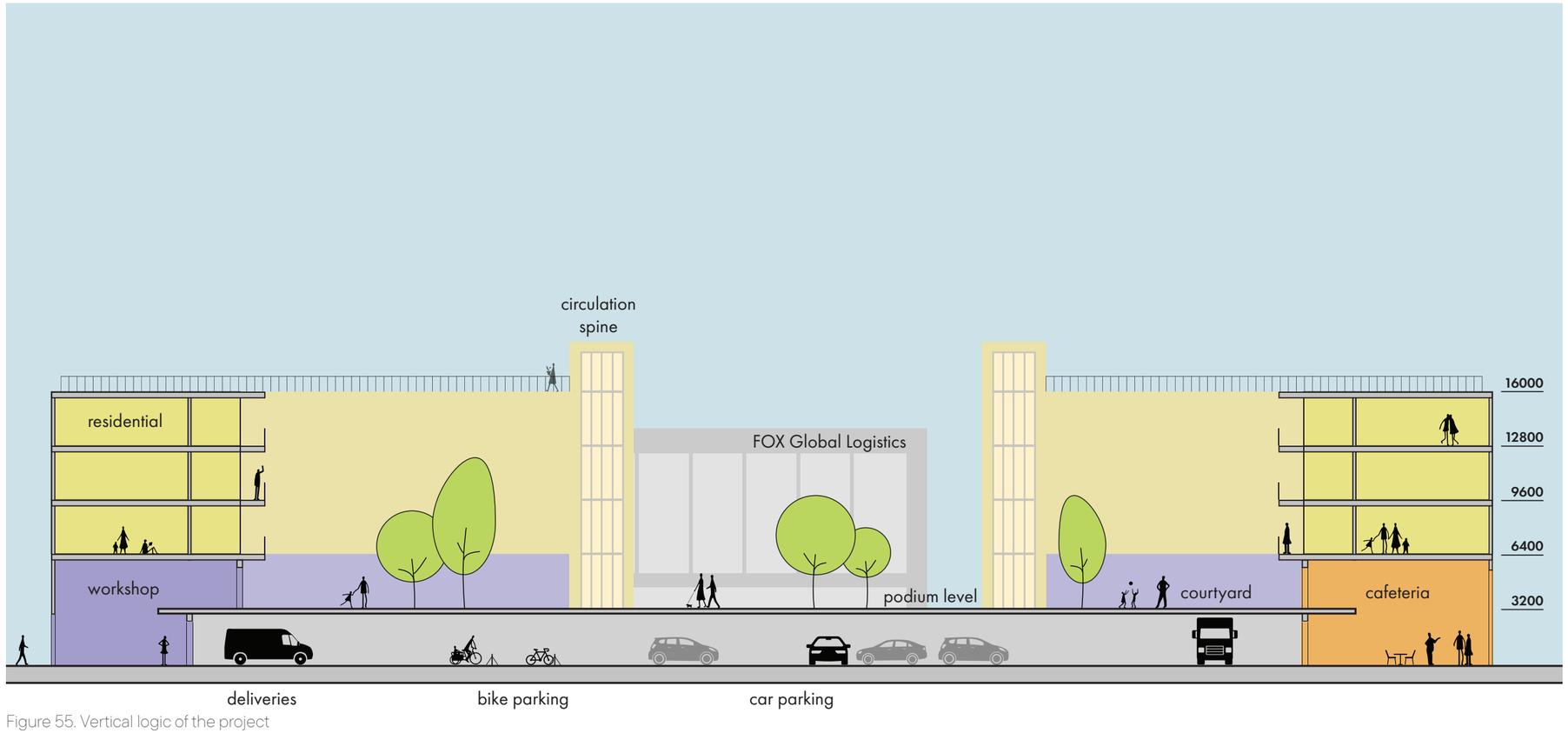


Figure 55. Vertical logic of the project

4. Form, Functions & Urban Context

A. Form & urban response

Collective Living Size

Distributing the housing across three separate blocks rather than one large volume was also a deliberate choice, as smaller communities of around fifty people tend to develop stronger social ties.

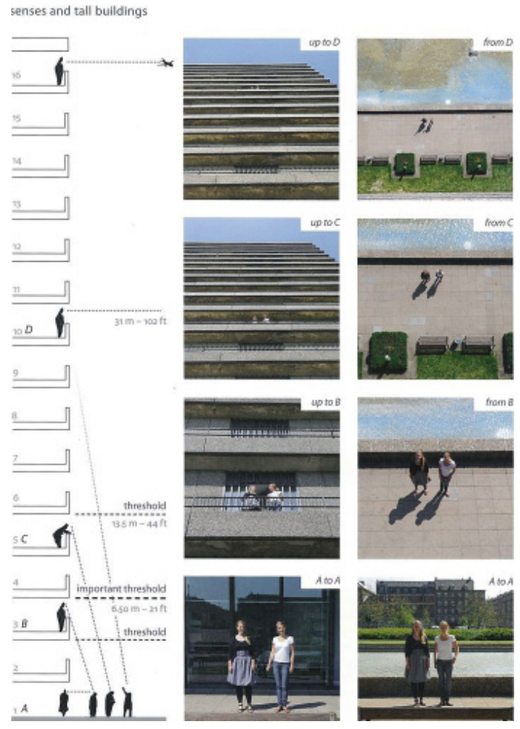
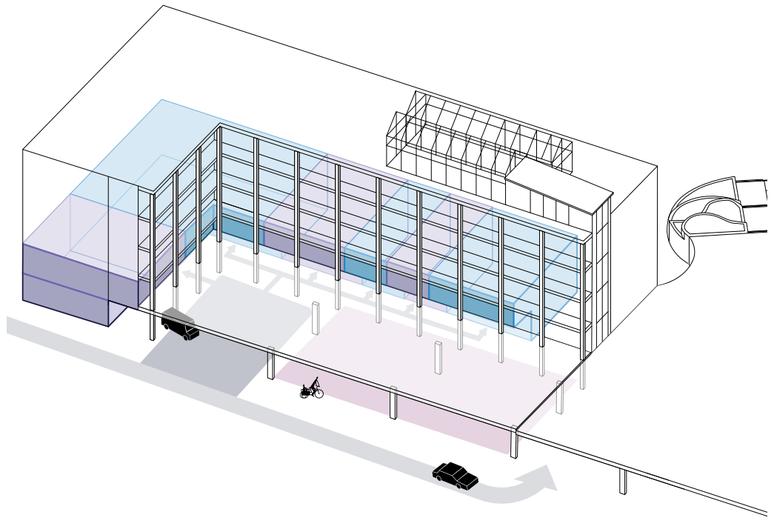


Figure 56. Extract from Gehl (2010) Cities for people

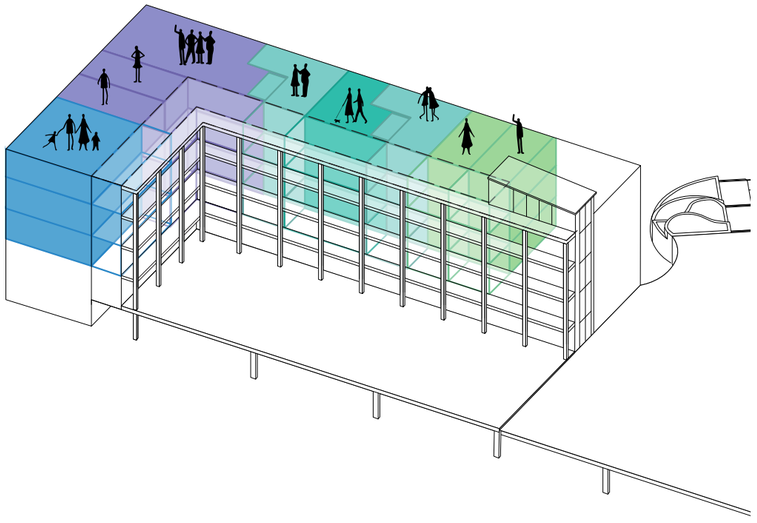
Figure 57. Research-based design rules

4. Form, Functions & Urban Context

B. Design Preview



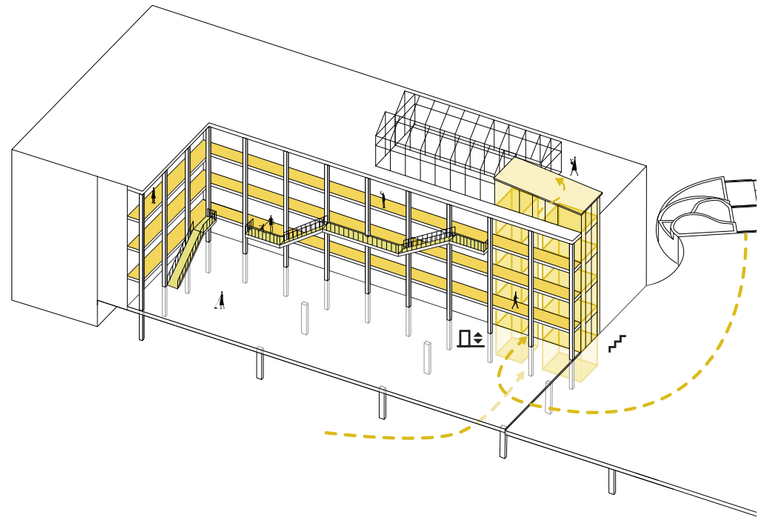
1 Deliveries, bike and vehicle parking under the podium.
Ease of access for the double height commercial/productive spaces on the ground floor.



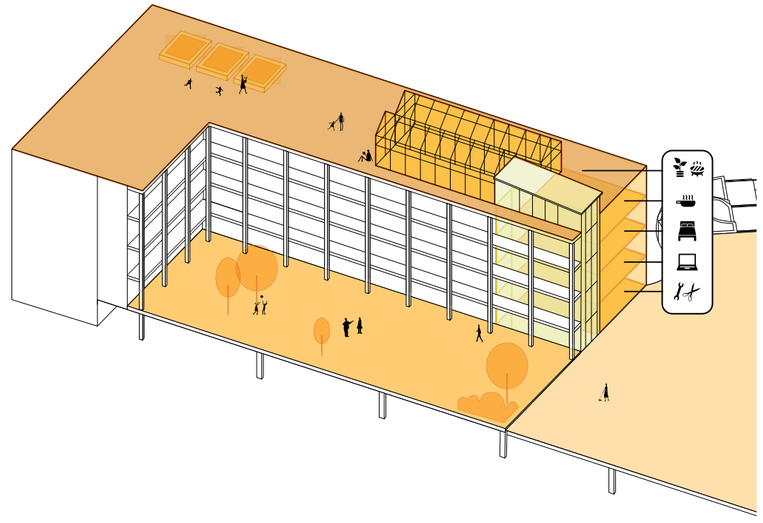
2 Winter gardens extend the living space of varied dwelling types, and buffers between private living and circulation.

4. Form, Functions & Urban Context

B. Form & urban response



3 Each building has one circulation spine that faces the podium. This means only one elevator is needed per block, to go from level 00 to 05. Galleries and exterior stairs connect to the dwellings.



4 Shared spaces next to the circulation to encourage interaction. These include: a repair cafe, work spaces, play spaces, guest bedrooms, hosting kitchen, roof terrace & greenhouse.

4. Form, Functions & Urban Context

C. Ground Floor & Parking

Parking (re) provision

The site currently functions as FOX's employee parking lot (263 spaces). It is unlikely the business will allow housing development if it reduces its parking. The parking is thus re-provided in a demountable, multi-storey car park located on the western edge of the site. The structure accommodates 300 spaces, replacing the existing parking while allowing for future resident parking needs.

Access to parking is made via the Nobelsingel, which is cut short to free up the waterside, and head straight to the separate parking structure, and to the back of the housing development.

Figure 58. Context Plan

4. Form, Functions & Urban Context

C. Ground Floor & Parking

Shared Mobility & Bike Parking

The housing development itself follows a low-parking strategy due to its proximity to public transport, with the metro reachable within a 10-minute cycle. Accessible parking spaces are integrated directly beneath the podium, alongside shared mobility facilities including electric shared cars and scooters for residents.

Bike parking is conveniantly located near the lobbies and circualtion cores.

Mixed-Use Ground Floor

Double height workshops and commercial spaces occupy the north-facing ground and first floors of the development, gainings sufficient light from large, double height curtain walls and benefitting form an attractive position along the walk and cycle way along the polder edge.

The cafeteria is a double height space that fronts the lake.

Deliveries arrive form the road at the south west side of the site, and can be unloaded right in front of each workshop and the cafeteria.

Figure 59. Ground Floor Plan

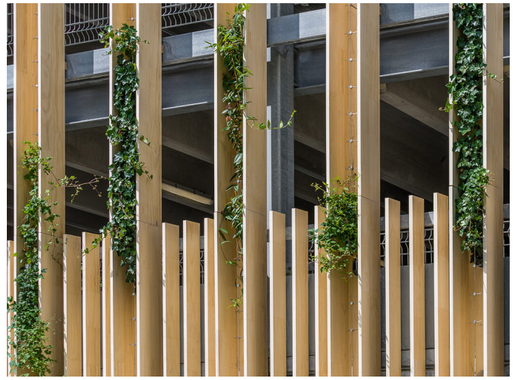
Detached Parking Structure

Demountable

The design is a demountable, modular parking structure inspired by the Parking Garage Rotterdamseweg (WURCK, Delft), using a steel frame and precast concrete floors for flexibility and circularity. It can be taken apart and reinstalled elsewhere when parking demand reduces.

Nature Inclusive

A timber façade system softens the structure while improving ventilation and enabling nature-inclusive features such as bird boxes and climbing plants. Bat, bird and insect boxes should be located North or East, to avoid harsh heat in summer and protected from the worst weather. This is ideal for this site.



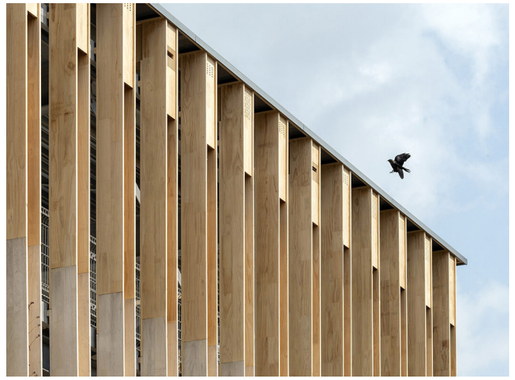


Figure 60. Parkeergebouw Rotterdamseweg, Delft

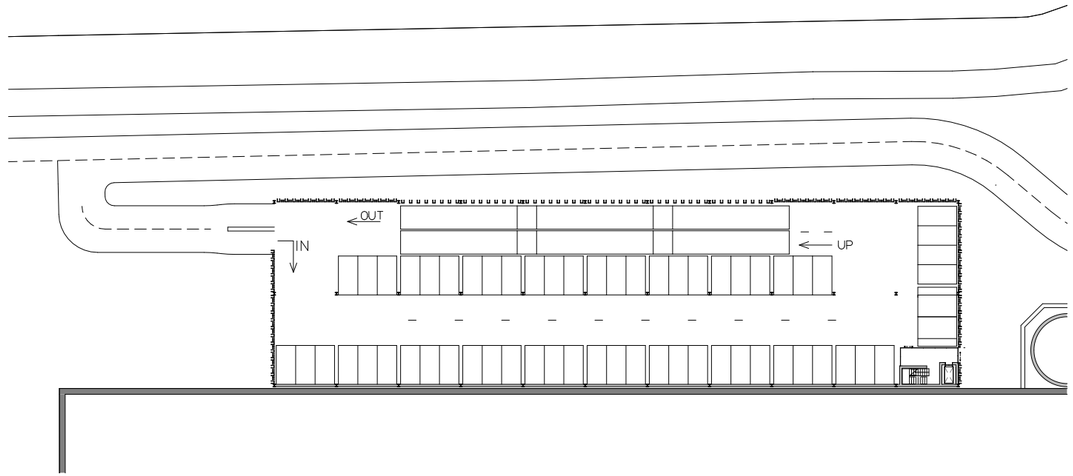


Figure 61. Ground floor plan of the mutli-storey parking

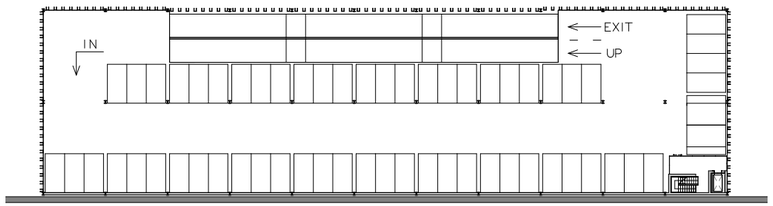


Figure 62. Standard floor plan of the mutli-storey parking

4. Form, Functions & Urban Context

D. Public Spaces

The Podium

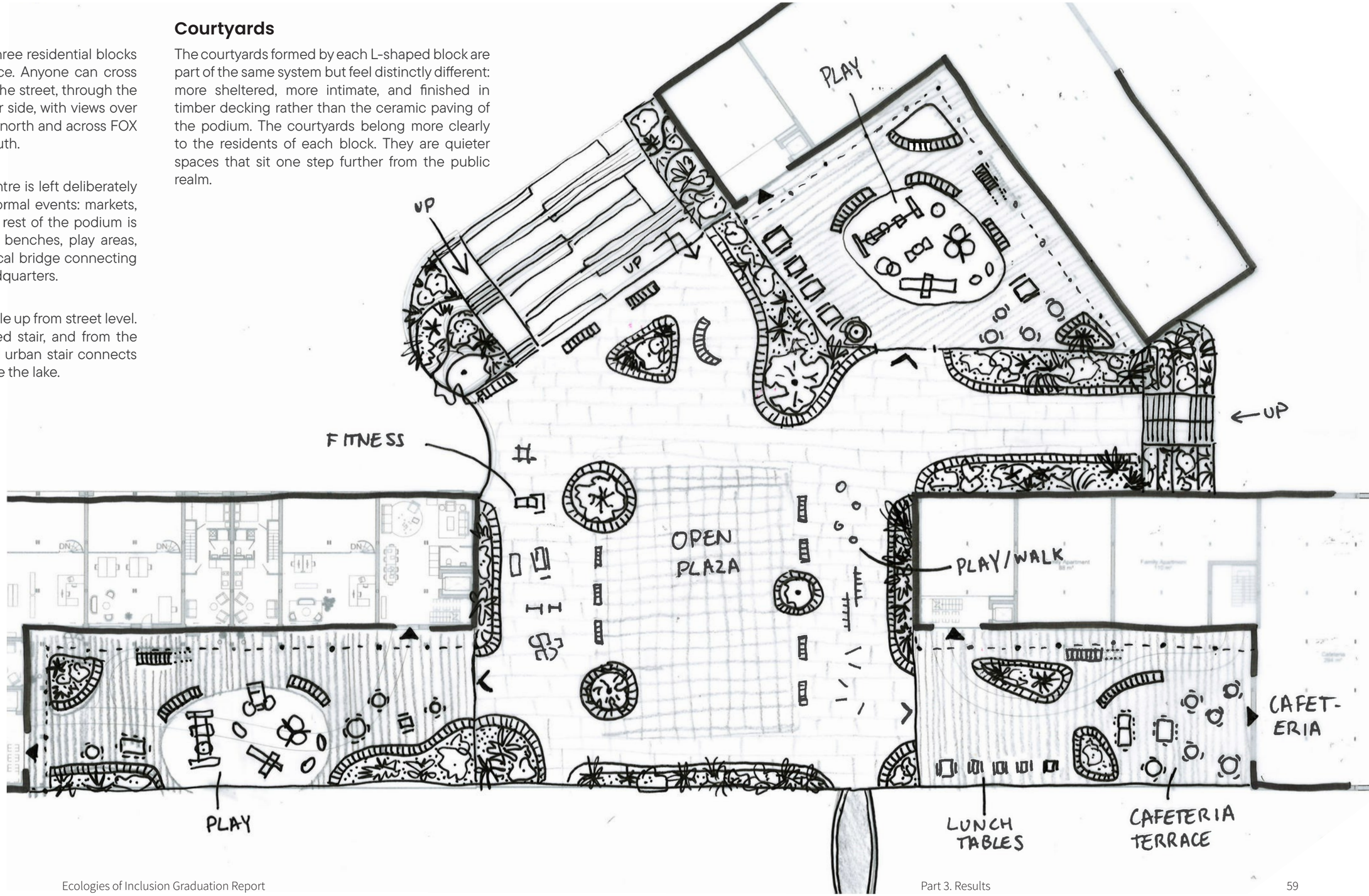
The podium connects the three residential blocks and doubles as public space. Anyone can cross the site by walking up from the street, through the podium, and down the other side, with views over the polder landscape to the north and across FOX Global's truck yard to the south.

A large open area in the centre is left deliberately open to leave space for informal events: markets, screenings, gatherings. The rest of the podium is planted and furnished with benches, play areas, outdoor tables, and a physical bridge connecting the housing to the FOX headquarters.

Two sets of stairs bring people up from street level. From the west, a landscaped stair, and from the east, a more straightforward urban stair connects directly to the road alongside the lake.

Courtyards

The courtyards formed by each L-shaped block are part of the same system but feel distinctly different: more sheltered, more intimate, and finished in timber decking rather than the ceramic paving of the podium. The courtyards belong more clearly to the residents of each block. They are quieter spaces that sit one step further from the public realm.



4. Form, Functions & Urban Context

D. Public Space

The Landscaped Stairs

This stair catches the evening sun and is designed as a feature in itself: wide steps for sitting, integrated planters, and a ramp for wheelchair users and buggies. The organic forms of the planters reveal an entrance to the bike parking.

5. Structure & Materials

A. Structure

Criteria

The material and structural choices respond to the environmental limits, affordability and adaptability goals of the project.

1. Low carbon materials

The building industry is responsible for 13% of annual global emissions. 23% of global emissions are generated by the production and use of concrete, steel, and aluminium. Reducing embodied carbon is a key objective. I therefore chose timber as the primary structural material in this project. Compared to the aforementioned materials, timber:

- has a far smaller carbon footprint, and stores carbon through its lifespan
- is lightweight, which can reduce foundation requirements
- has better circular properties

2. Simple construction

Affordability and buildability were equally important. A simple and regular structural grid allows repeated elements, standard dimensions, and efficient prefabrication. This can shorten construction time, reduce errors, and minimise material waste.

While innovative construction can be better envrionmentally or structurally, it can also increase cost and complexity. Therefore, some decisions prioritised robust construction methods close to industry standards, to balance innovation with affordability.

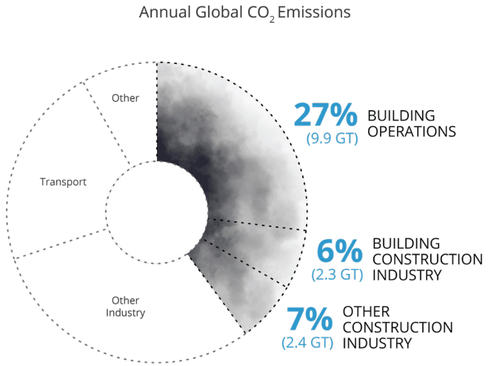
3. Flexibility and demountability

In a context of changing needs and resource scarcity, long-life, adaptability, and reusable structures are increasingly important. Therefore, the project favours dry construction methods, bolted or screwed components rather than permanently bonded. This improves repairability, allows future disassembly, and supports the reuse of materials and components.

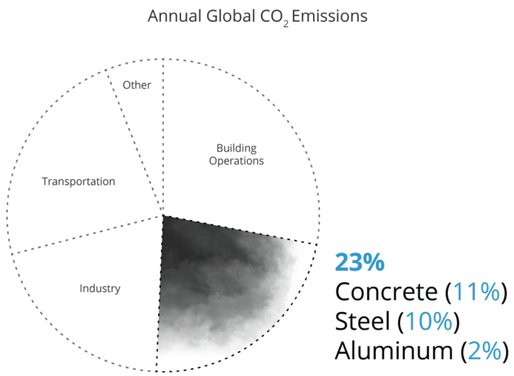
Grid: flexibility vs material use

Structural spans have a trade-off. Smaller spans (3-4m) use less material and lower embodied carbon, while larger spans (7-9m) offer more open and flexible floorplans.

Mixed-use developments often solve this with different structural grids for commercial lower floors and residential upper floors, but transfer structures add cost and complexity. For this relatively small site, a regular timber column and beam system was chosen. Keeping the walls non-load bearing allows for sufficient flexibility, double height spaces, and avoids unnecessarily large spans and complex structural solutions.



Building Construction Industry and Other Construction Industry represent emissions from concrete, steel, and aluminum for buildings and infrastructure respectively.



5. Structure & Materials

A. Structure

Construction system

Glulam columns & beam system

A regular glulam frame provides the main structure, ensuring simplicity, strength, and long-term adaptability.

CLT cassette floors

Prefabricated CLT cassette floors provide lightweight slabs with good acoustics and flexible integration of services.

Non load bearing, timber stud walls

Lightweight timber stud walls, filled with biobased insulation are supported by the column and beam structure, allowing internal layout changes over time.

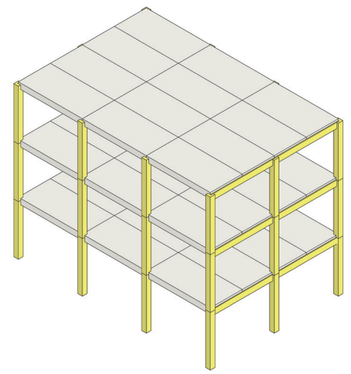


Figure 63. Glulam column and beam construction

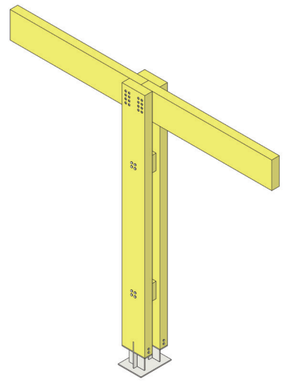


Figure 64. Glulam column base and beam connection

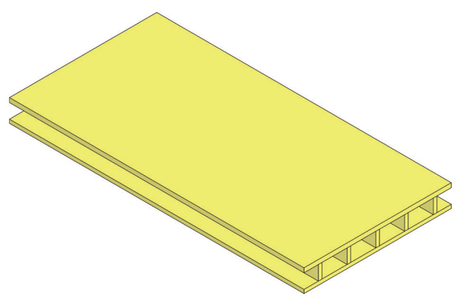


Figure 65. CLT cassette floor

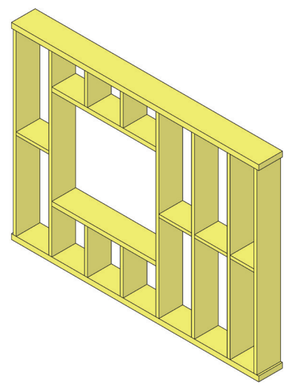
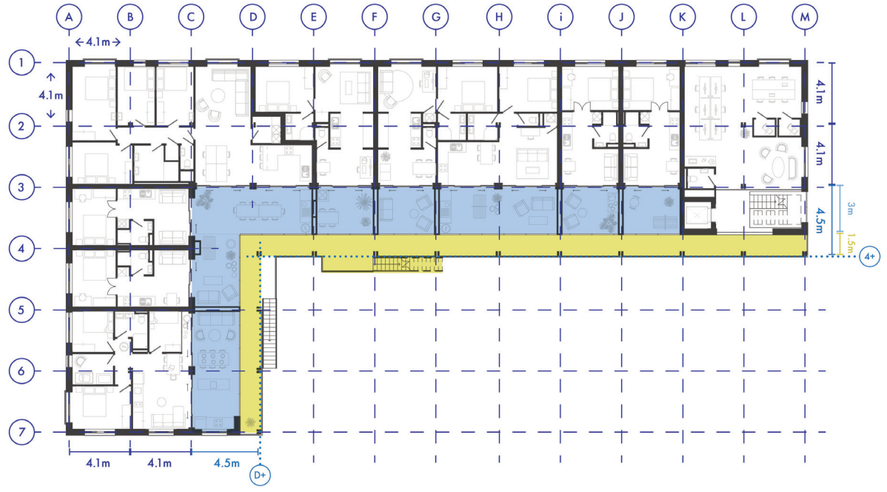


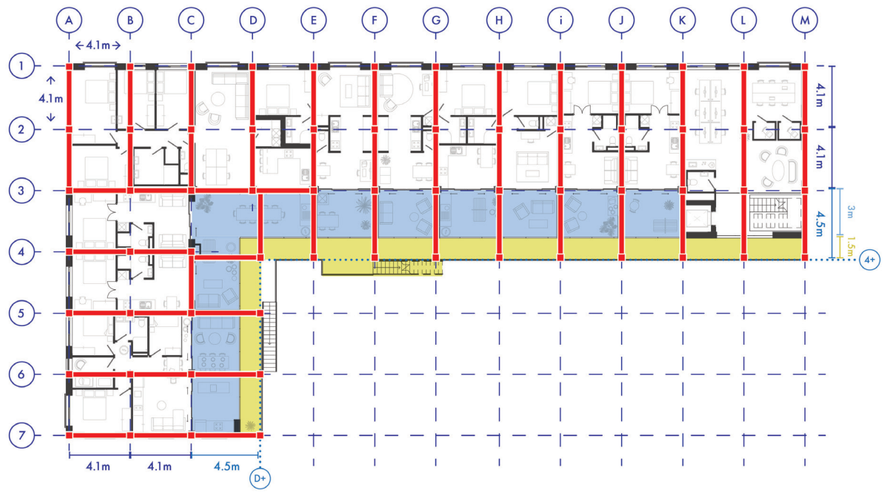
Figure 66. Timber Stud Wall construction

5. Structure & Materials

A. Structure



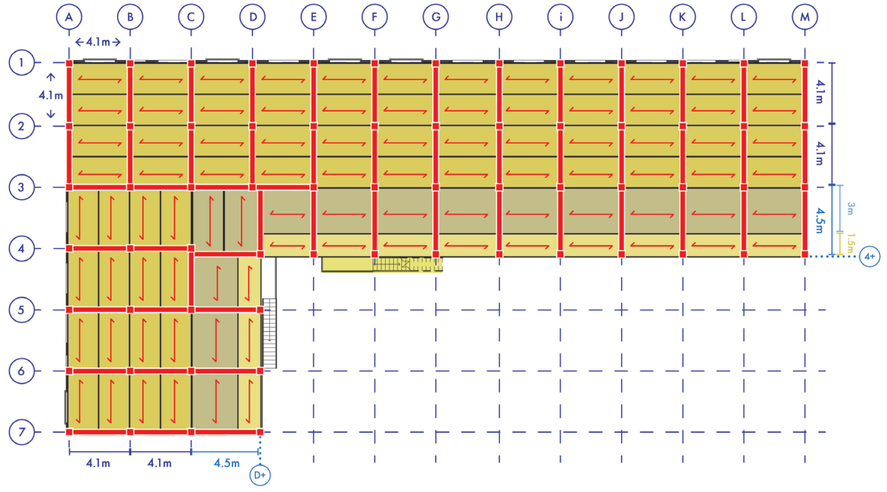
A regular, square 4.1m grid.
It is widened to 4.5m to allow for a 3m deep winter garden, and 1.5m of circulation space.



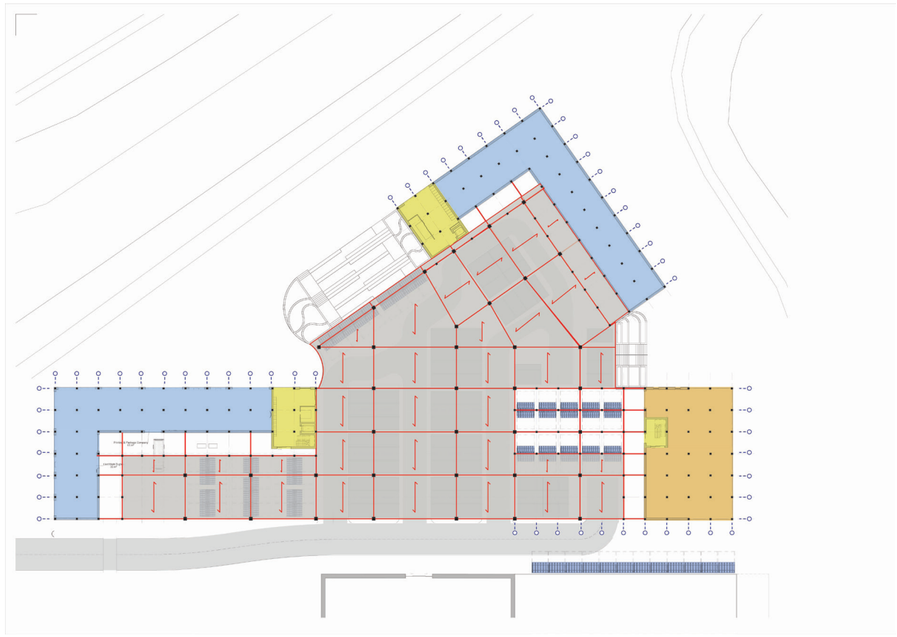
Glulam columns and beams leave the plans and facades free for future modifications.
The exception to the grid that occurs in the interior corner (grids D+ and 4+) is solved via 2 extra supports spanning from beams to column.

5. Structure & Materials

A. Structure



4.1 - 4.5m long, and 1.5 - 3m wide CLT cassette floors span in one direction between beams.



3 climate zones: 3 floor strategies

The same CLT cassette floor is used throughout the building. Depending on the climate zone: apartment, winter garden, and circulation, a different infill and finish is used.

In the apartments, underfloor heating is used, requiring lower water temperatures than conventional radiators. Insulation beneath directs heat upward rather than into the structure below, while also improving acoustic performance between floors.

In the winter gardens, porcelain pavers on adjustable pedestals provide thermal mass in a dry and demountable system. In winter, solar heat gains are absorbed by the pavers and released gradually into the evening. In summer, the floor stores cooler night temperatures and helps cool the space in the day.

In the circulation zones, a lightweight raised timber deck is simple, affordable, and replaceable.

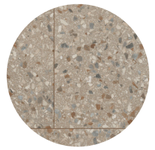
Beneath the winter garden and circulation finishes, sloped layers of Marmox™ Multiboard, covered with a waterproof membrane, allow rainwater to fall toward gutters and protect the structural timber below.

Interior Floor - 393mm

Chosen floor finish material 25mm
Fermacell® Flooring with under floor heating 38mm
Rigid Insulation 20mm
Radiant Barrier Foil
CLT Cassette Floor 310mm
- CLT 60mm
- Timber joists 60x200mm / Insulation 200mm
- Timber Panel 50mm

Optional: plasterboard hung ceiling

Winter Garden Floor - 392.5mm



1200 x 1200mm Terrazzo Allure™ recycled porcelain tile 20mm
62.5 mm: Adjustable tile pedestals
- Waterproof membrane
- Marmox™ sloped waterproof multiboard, 50-25mm

CLT Cassette Floor 310mm
- CLT 60mm
- Timber joists 60x200mm / Insulation 100mm
- Timber Panel 50mm

Circulation Floor - 392.5mm

Treated Timber Planks 20mm
62.5mm: Timber Battens 50mm, 45mm, 40mm
- Waterproof membrane
- Marmox™ sloped waterproof multiboard, 25-12.5mm

CLT Cassette Floor 310mm
- CLT 60mm
- Timber joists 60x200mm
- Timber Panel 50mm

5. Structure & Materials
B. Details

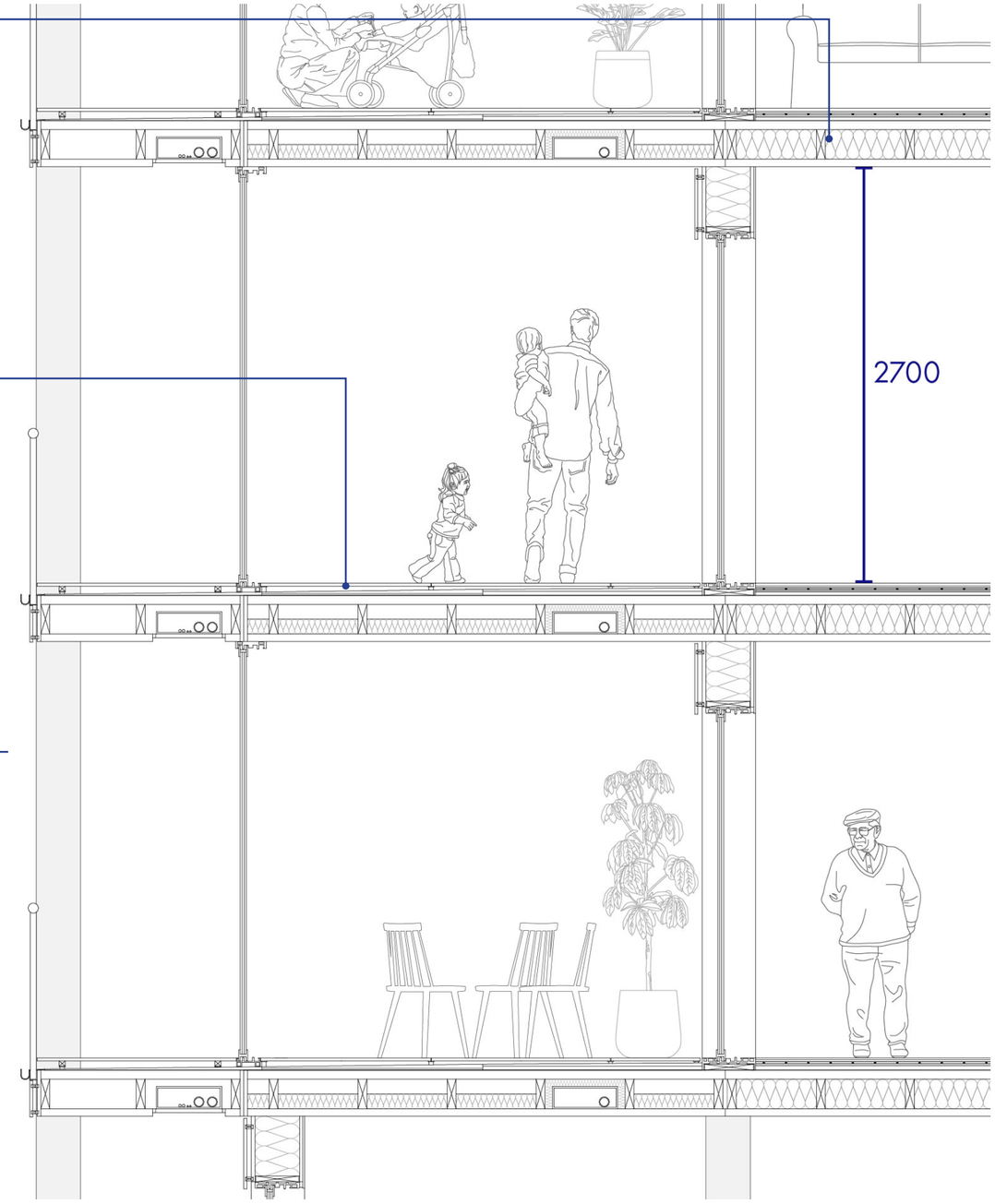


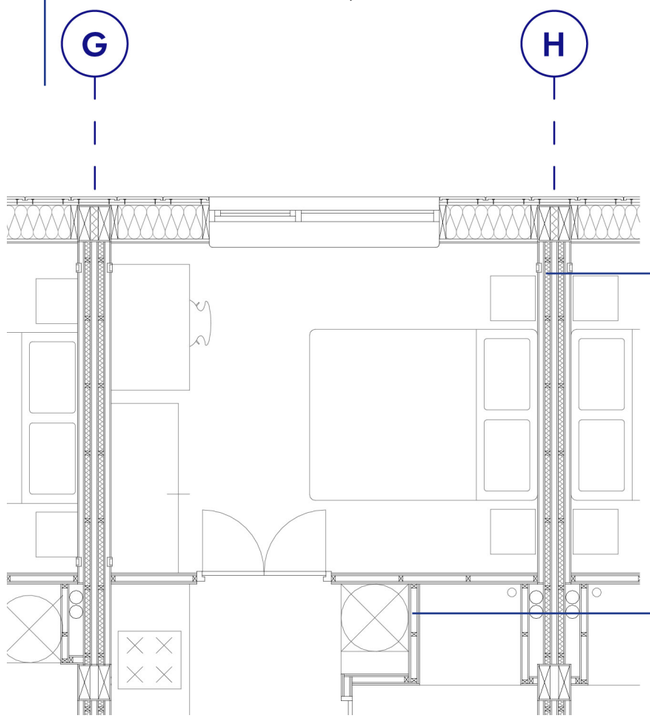
Figure 67. Detail Section

5. Structure & Materials

B. Details

Exterior Wall -412.5mm

Plasterboard 12.5mm
Fibre Cement Board 25mm
Damp-proof Vapour Barrier
Timber studs 60x300mm, 600mm spacing/ Hemp Wool Batt Insulation 300mm
Fibre Cement Board 25mm
Damp-proof Vapour Barrier
KeraTwin® Vertical T-profile K20 Fastening System 30mm
KeraTwin® K20 facade panels 20mm



Apartment Partition Wall-300mm

Plasterboard 12.5mm
Service Cavity 40mm
Timber Studs 35x50mm
Plasterboard 12.5mm
Air Gap 45mm
Plasterboard 12.5mm
Timber Studs 35x50mm
Service Cavity 40mm
Plasterboard 12.5mm

Standard Partition Wall-100mm

Plasterboard 12.5mm
Timber Studs 35x50mm
Plasterboard 12.5mm

Figure 68. Detail Plan

5. Structure & Materials

B. Details

Roof

A flat roof with a similar CLT cassette floor structure, but 100mm deeper, to allow for extra insulation, and withstand the extra weight of planters. large recycled ceramic pavers on adjustable pedestals to allow water to drain to the gutters.

Podium

steel deck podium

also nice if it holds the weight of planting

Ground Floor

A 50mm concrete screed finishes the floors in the workshops and commercial areas on the gorund floor. This sits on top of a 200mm reinforced concrete floor. Foundations sit under each glulam column.

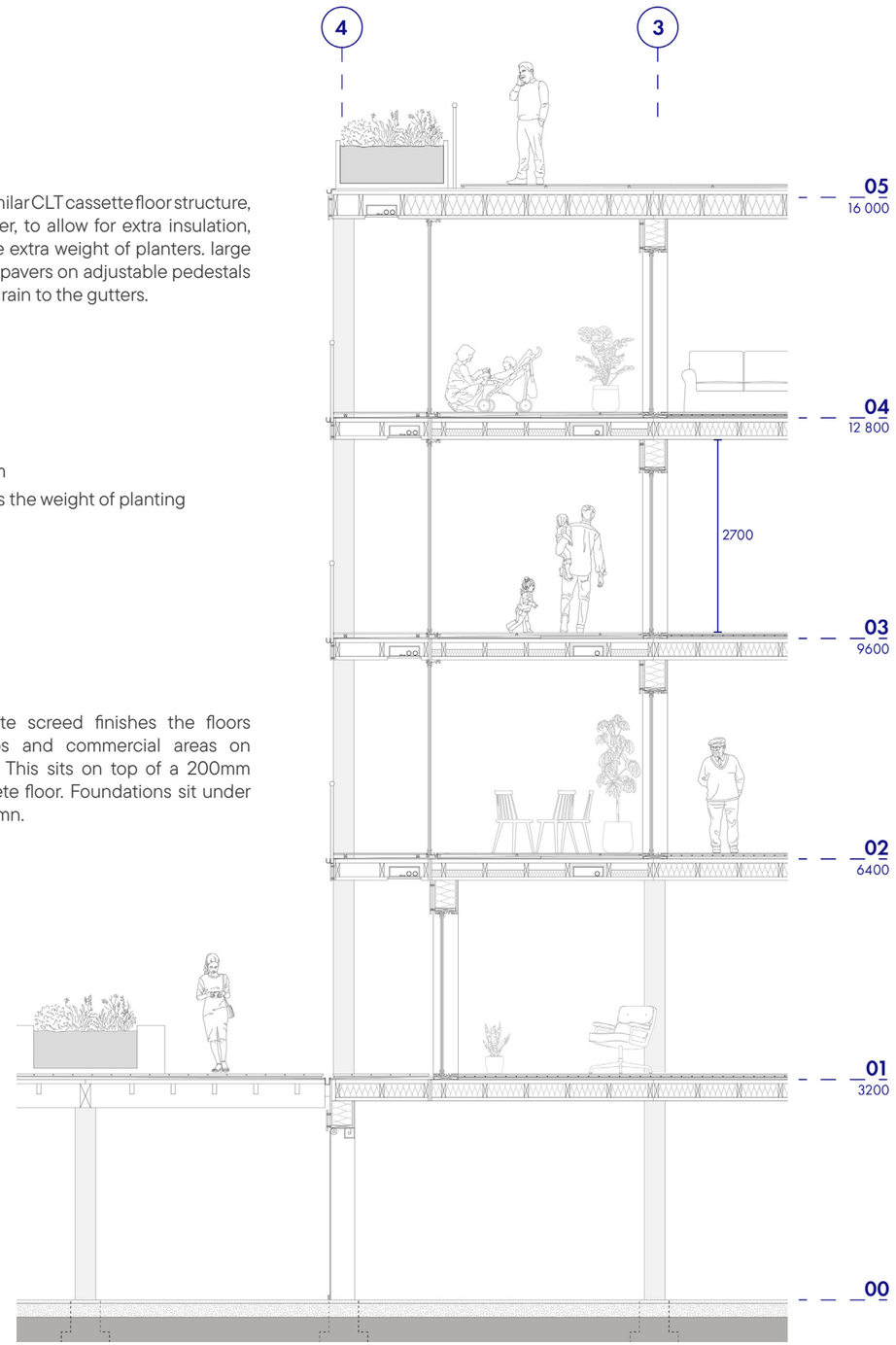
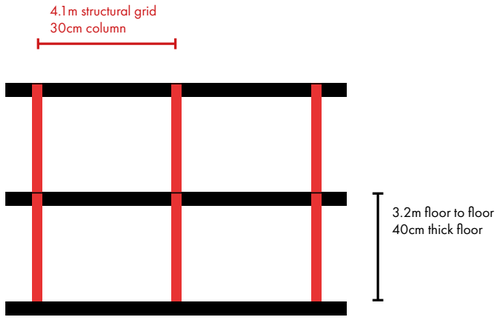
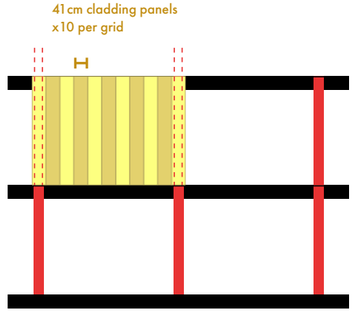


Figure 69. Detail Section

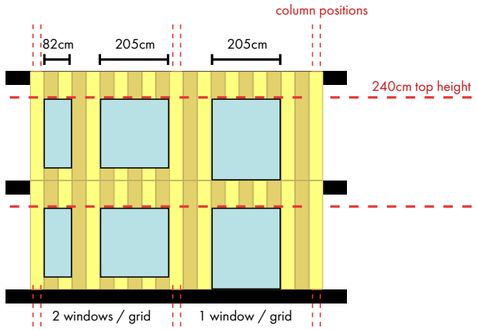
5. Structure & Materials
C. Facade System



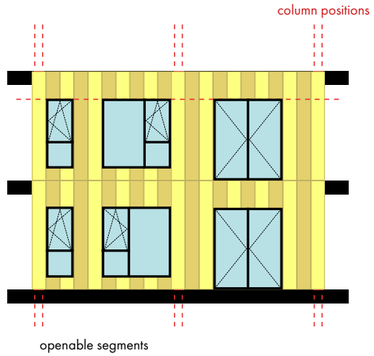
1 30cm wide columns at 4.1m meter intervals, 40cm thick floors, 3.2m floor to floor height



2 one 4.1m grid interval is split into 10, 410mm wide cladding panels



3 Windows are 2 or 5 panels wide, and aligned to the top height of 2400mm. The larger windows are square while some go to the floor.



4 Double doors to french balconies open inwards. The square and narrow windows are split in a similar fashion, and have openable panels.

5. Structure & Materials
C. Facade System

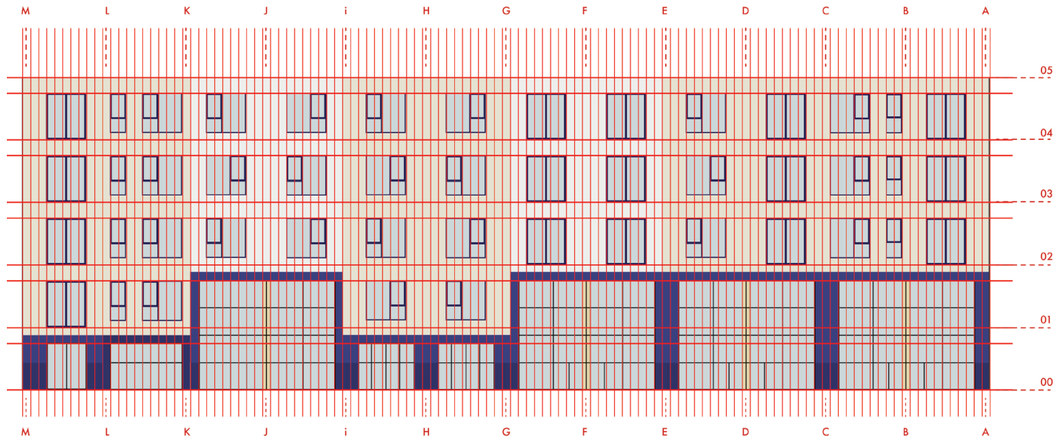


Figure 71. Northern elevation of building A, split into 410mm panels

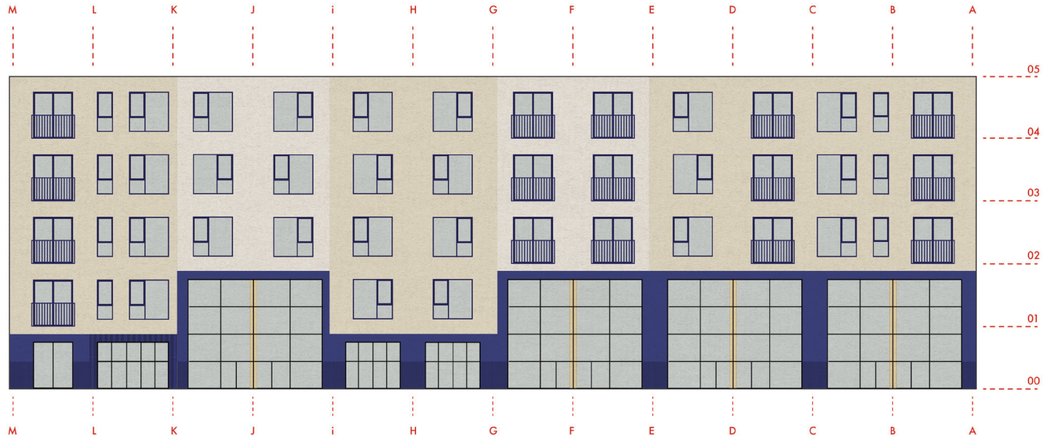


Figure 70. Northern elevation of building A

5. Structure & Materials

D. Elevations

Street-side Elevation

The street side elevation is clad in affordable, light coloured bio-based panels arranged on the 4.1m structural grid. This references the panelling used across sheds in the industrial setting. At street level, a more expensive ceramic tile is used to create a play of texture and colour. Both panels use a clip-on system that requires no mortar, which means they are easy to replace or disassemble.

The result is a building inspired by it's context. I argue that brick isn't always needed for a place to look like home. Railings and human-level details bring interest and materiality to the elevation.

See Appendix K for elevation design process and technical specifications of cladding materials

① Nabasco 8010 Fire - 6mm

- Extra fire-resistant bio-based panels made with reed fibres
- 50 year lifespan
- Minimal discolouration for light colours
- Affordable option compared to other bio-based equally long-lasting options

(Durzame gevelmaterialen, Merwerde LAB, 2025)

- Mounted on wood battens or typical mounting systems, can be blind mounted
- minimum 600mm between fixing points, fixations minimum 20 mm from the edge of the panel

Smooth, natural riet panels

Smooth, light beige/natural grey

② Agrob Buchtal KeraTwin® K20

- Ceramic tiles
- wide availability of panel sizes up to 60 x 180cm
- 3D or textured options, glazed/mat options, very wide range of colours
- more expensive
- easy to maintain, you can upgrade to they Hytect technology that needs very little cleaning maintenance.

Colour 144 intense blue H

Grooved positive panels up to 2100mm

Smooth panels for the rest

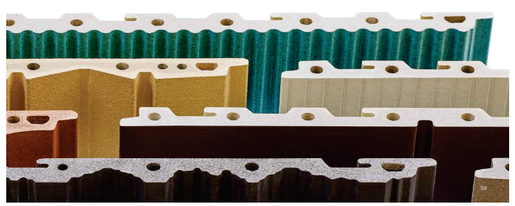


Figure 72. Agrob Buchtal ceramic facade tiles

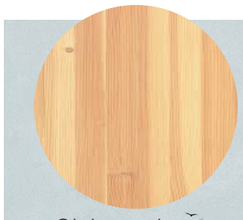
5. Structure & Materials

D. Elevations

Courtyard-side Elevation

The courtyard elevations are entirely different in character. Here, the timber columns and beams are left visible, and the winter gardens are enclosed with polycarbonate panels that open and close depending on the season. The effect is warmer and more domestic than on the street. Inspired by lacaton and Vassal, the logic of the structure and generous spaces are celebrated, but translated into a timber construction system rather than steel.

Figure 73. Leyhof Housing Complex, by Studio Ard Hoksbergen. The Hague, 2022.



Glulam columns and beams

Winter Gardens

Circulation spines

Figure 74. WOHNEN HOCH DREI, by Limbrock Tubbesing Architekten und Stadtplaner. Hamburg, 2025

Figure 75. Courayrd side elevation

6. People & Dwellings
A. Target Groups

Households in the Netherlands are changing. As explained in the problem statement, our homes are getting larger and our households smaller. In 2022, almost half of all Dutch households consisted of two people, while more than 20% of people lived alone (CBS, 2022).

Because this project is located in an unconventional setting: the renewed mixed-use Rodenrijs Polder, with strong connections to major employment centres such as Rotterdam, I expect young adults at the start of their careers to be slightly overrepresented compared to national averages. This includes both singles and couples seeking affordable, well-connected housing in a mixed urban environment.

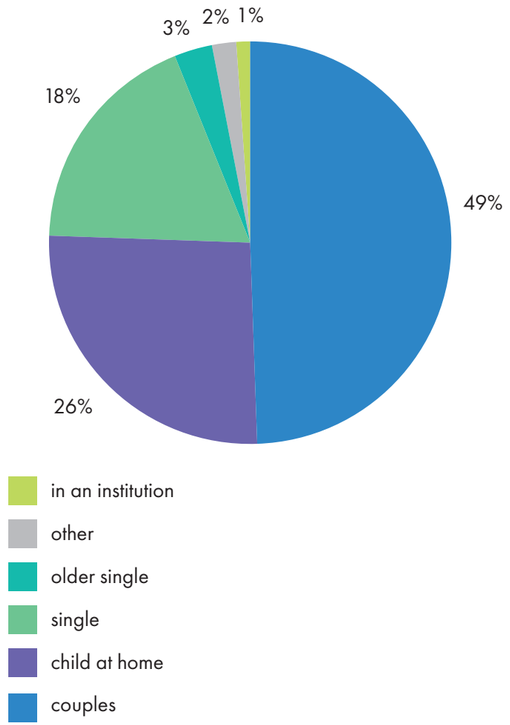


Figure 76. Household Composition in the netherlands.Source: CBS, 2022. Adapted from De Zwarte Hond. (2023)

This was a very useful book to study a wide variety of dwelling floor plans.

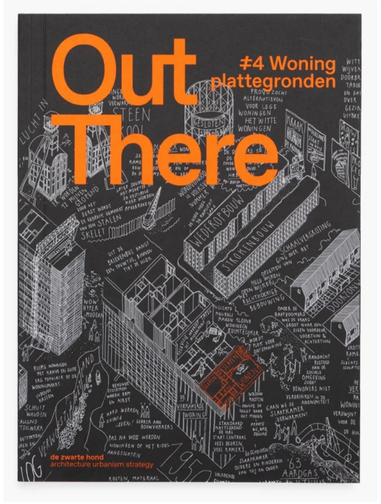


Figure 77. De Zwarte Hond. (2023). OutThere #4 – Woningplattegronden.

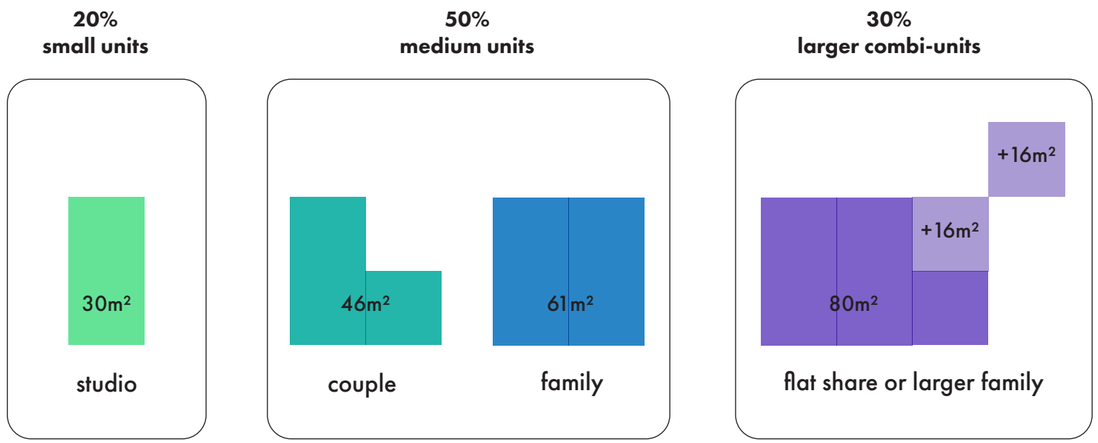
Figure 78. Figure 03. Single households in the Netherlands (CBS, 2025)

6. People & Dwellings
A. Target Groups

Based on this, I defined the following target group mix for the project: 50% couples, mainly young starters, with some likely to plan for children in the coming years. 30% singles, primarily young adults living alone or in flatshares, but also including middle-aged and older residents, such as single parents with part-time childcare needs. Lastly, 20% families with one, two, or three children. This distribution then informed the dwelling mix.

Program	Dwelling Brief
50% couples	compact units, include work from home space
30% singles	smallest units: independent flats some larger **flat sharing** combinations
20% families	compact family apartments with multiple rooms for children, larger outdoor spaces

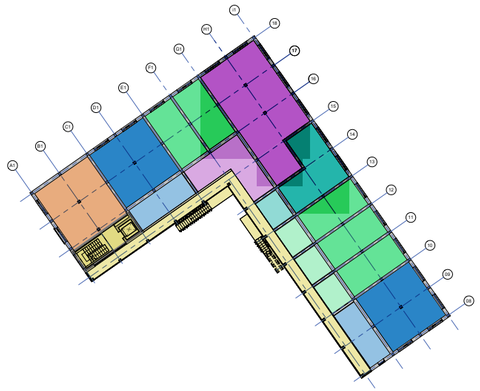
Dwelling Sizes



6. People & Dwellings

B. Floor Plans

- studio - 30 m²
- couple - 46 m²
- couple - 46 m²
- family M- 64 m²
- family L - 84 m²
- flat share - 108 m²
- shared spaces
- core
- circulation



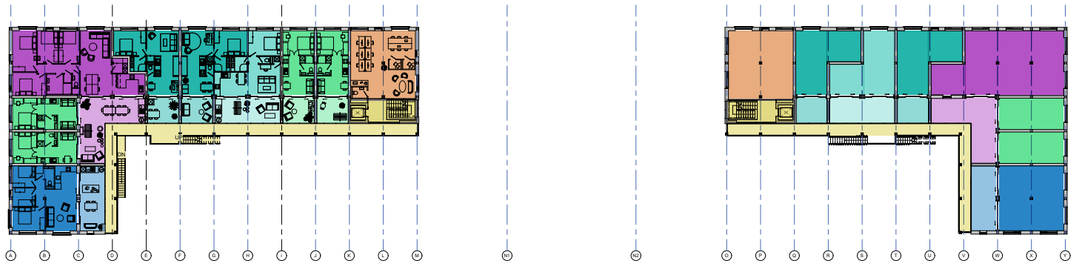


Figure 80. Level 02 Floor Plan

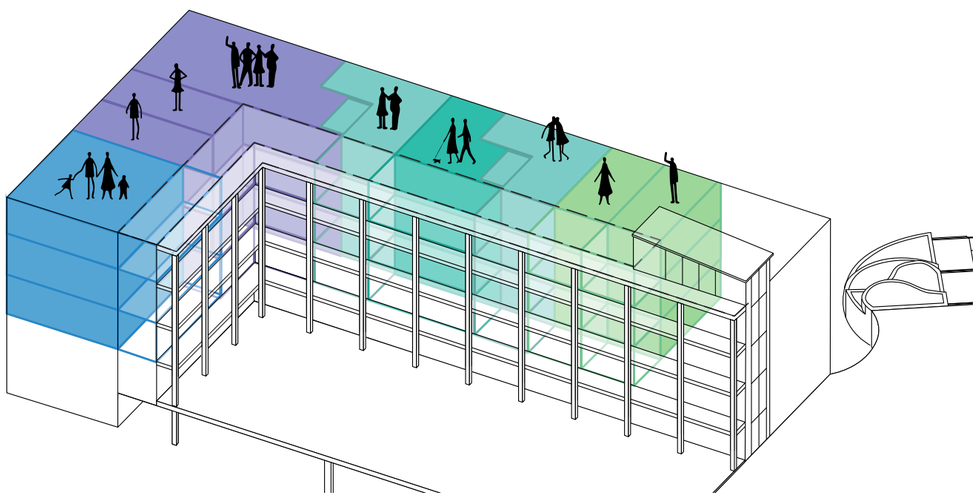


Figure 81. Dwelling Types Diagram

6. People & Dwellings

B. Floor Plans

Building A							
dwelling type	beds	people	m^2	level 01	level 02/03/04	total	total people
Work-Live	1	1	36.5	3		3	3
Studio	1	1	30		4	12	12
Couple	1.5	2	46		3	9	18
Family (M)	3.5	4	61	1	1	4	16
Family (L)	4.5	5	84			0	0
Flat share	4	4	108		1	3	12
		Total apartments/estimated inhabitants				**31**	**61**

Building B							
dwelling type	beds	people	m^2	level 01	level 02/03/04	total	total people
Work-Live	1	1	36.5	4		4	4
Studio	1	1	30		5	15	15
Couple	1.5	2	46		1	3	6
Family (M)	3.5	4	61	1	2	7	28
Family (L)	4.5	5	84				0
Flat share	4	4	108		1	3	12
		Total apartments/estimated inhabitants				**32**	**65**

Building C							
dwelling type	beds	people	m^2	level 01	level 02/03/04	total	total people
Work-Live	1	1	36.5			0	0
Studio	1	1	30		2	6	6
Couple	1.5	2	46		3	9	18
Family (M)	3.5	4	61	1	1	4	16
Family (L)	4.5	5	84	1		1	5
Flat share	4	4	108		1	3	12
		Total apartments/estimated inhabitants				**23**	**57**

Note: these estimated number of inhabitants include children. So the group sizes per block follow the guidelines found in research on collective living group sizes.

7. Luxury Reinvented
A. Apartments & Winter Gardens

Directly inspired by Lacaton & Vassal's approach in projects such as the Neppert Gardens (see figure 78), the project adopts the winter garden as a central spatial device.

Each dwelling has a compact heated area but is extended by a 12–40 m² winter garden, functioning as an unheated, flexible buffer. These spaces expand perceived living quality, support everyday uses such as gardening, storage, and informal living, and act as thermal and acoustic mediation between the apartment and the shared gallery. The winter gardens create a gradient of privacy, and are an essential part of the dwelling model.

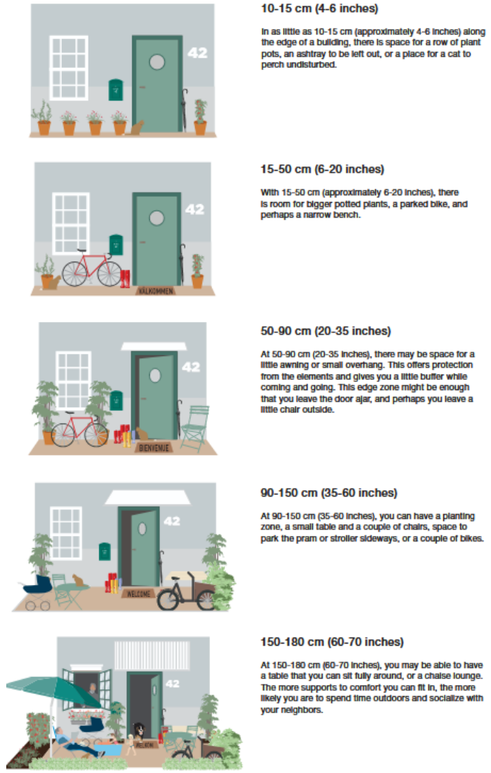


Figure 82. Sim, D. (2019). Soft city: Building Density for Everyday Life. Island Press.

7. Luxury Reinvented
A. Apartments & Winter Gardens

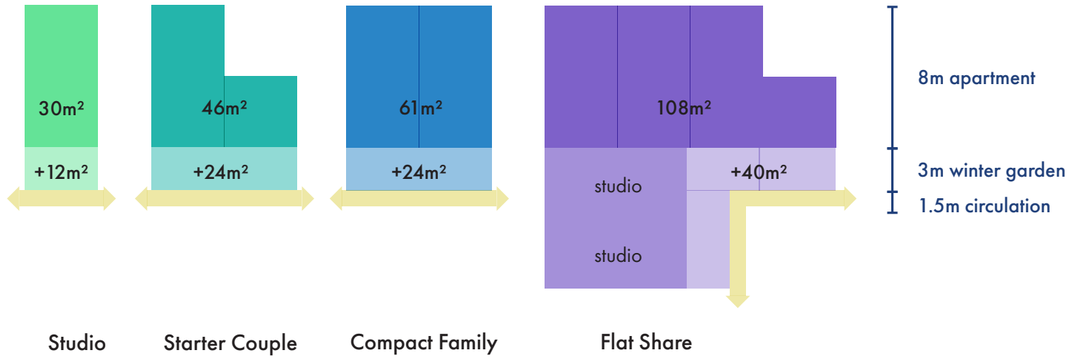


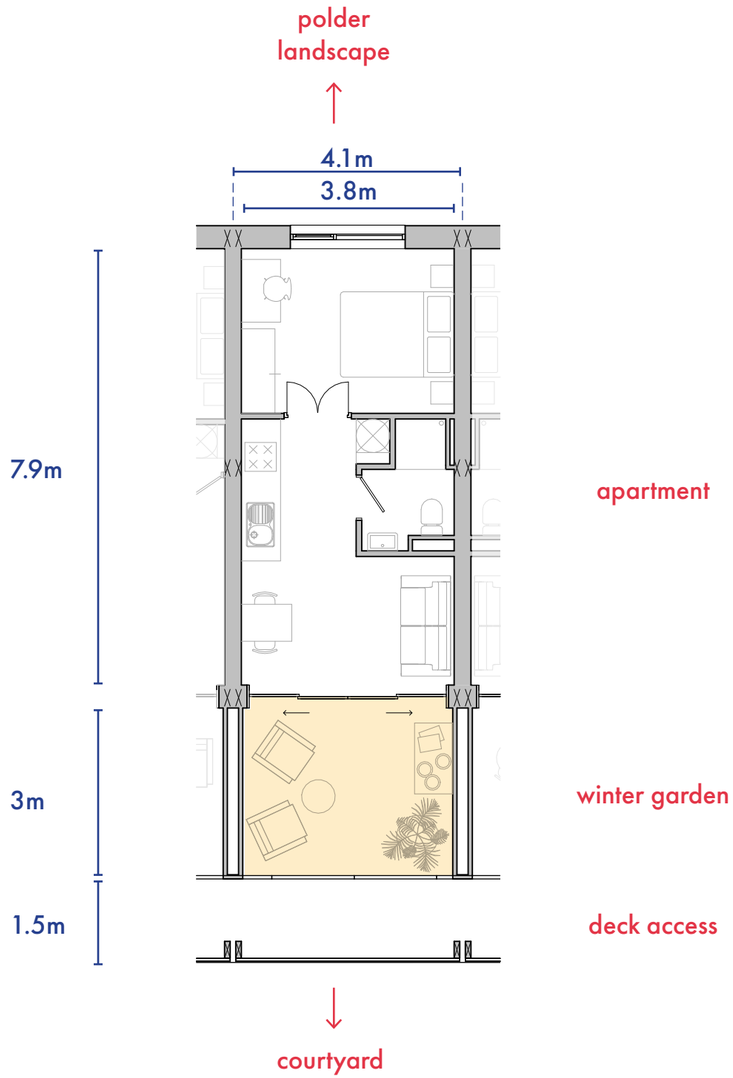
Figure 83. Dwelling types with their winter gardens

Figure 84. Neppert Gardens, Mulhouse, by Lacaton & Vassal

7. Luxury Reinvented
A. Apartments & Winter Gardens

Single / Studio Unit

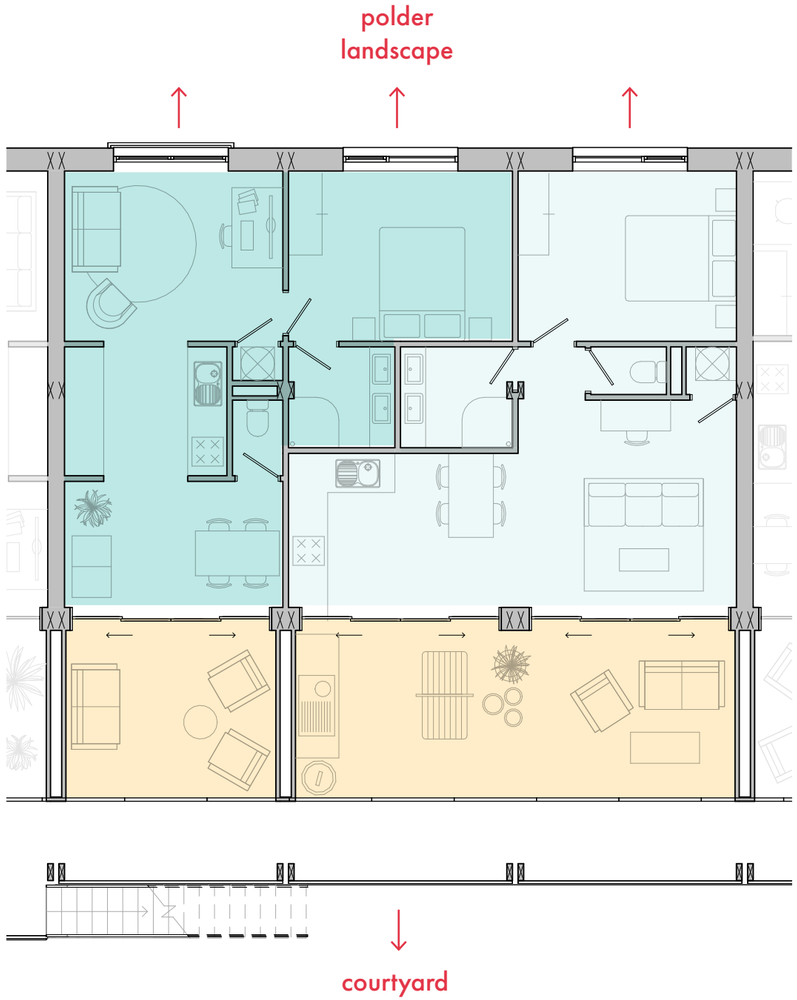
30m² apartment, 1 bed
+12m² winter garden
floors: 02, 03, 04
1:100 @ A3



7. Luxury Reinvented
A. Apartments & Winter Gardens

Starter Couple

46m² apartment, 1 bed
+12m² / + 24m² winter garden
floors: 02, 03, 04
1:100 @ A3

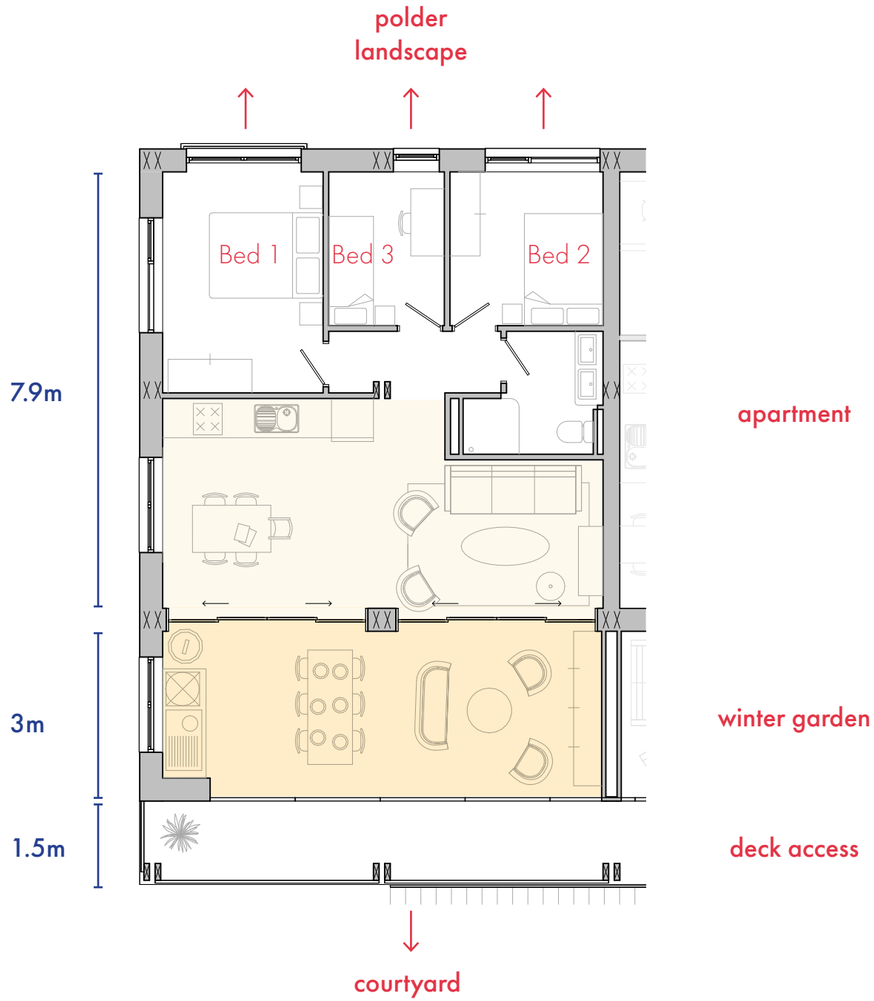


7. Luxury Reinvented

A. Apartments & Winter Gardens

Compact Family

61m² apartment, 3 beds
+24m² winter garden
floors: 02, 03, 04
1:100 @ A3



7. Luxury Reinvented

A. Apartments & Winter Gardens

Compact Family - option

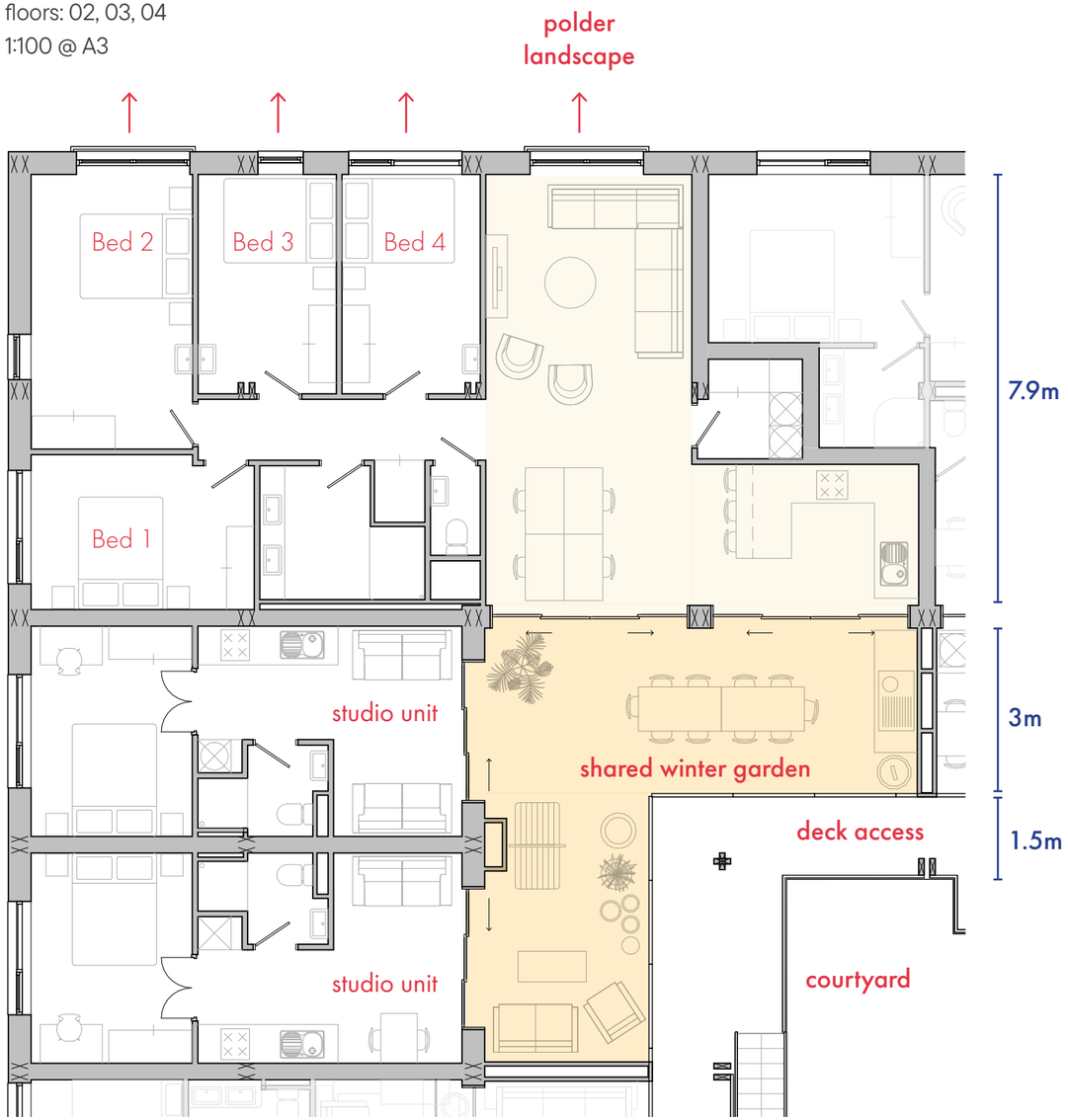
For changing needs: an office, another child, one extra room can be close off from the living space without changing the structure of the apartment.

7. Luxury Reinvented

A. Apartments & Winter Gardens

Flat share

108m² apartment, 4 beds
2 x 30m² single units
+40m² winter garden
floors: 02, 03, 04
1:100 @ A3



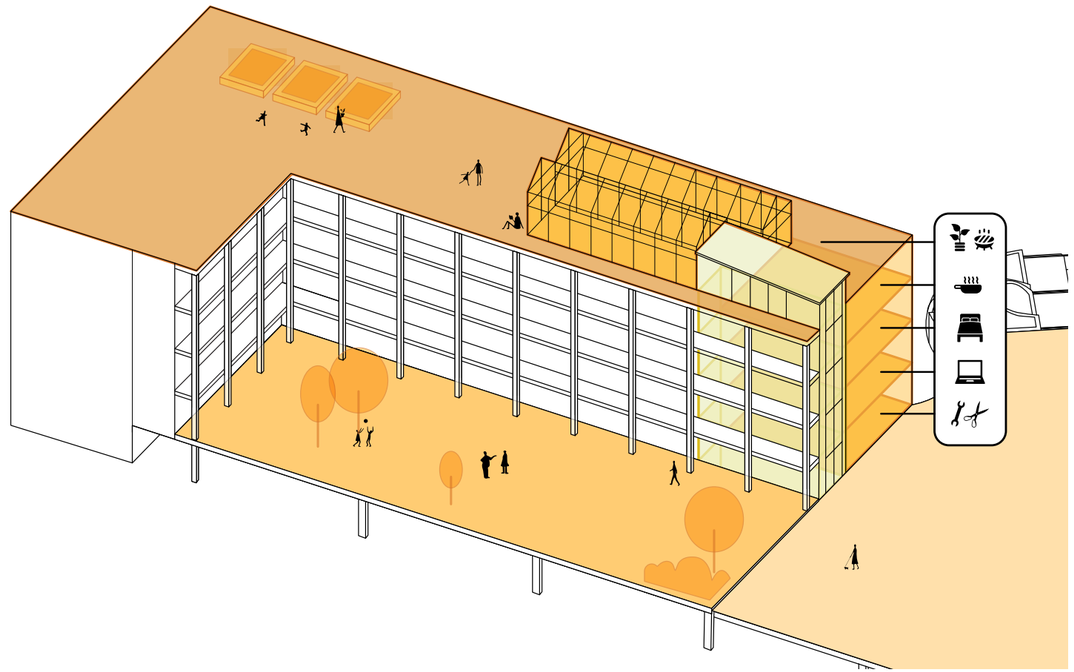
7. Luxury Reinvented

B. Shared Spaces

Each of the three residential blocks contains a set of shared spaces positioned deliberately alongside the main circulation spine. As residents move through the building, they pass directly by these spaces and can see whether someone is already there. This makes spontaneous use and chance encounters more likely.

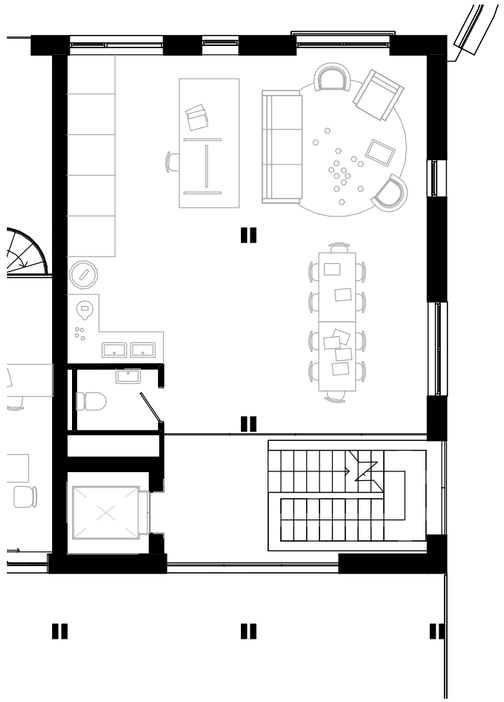
- The *library of things* reduces the need for each household to own appliances and tools they use rarely. It is on the podium level to be easily accessed with the wider community.
- The *co-working space* removes the pressure to fit a desk into every flat. It also features two calling cells to isolate yourself acoustically for a quick meeting.
- The *guest bedrooms* mean that residents do not need a spare room of their own.
- The *hosting kitchen* is large enough for communal dinners and celebrations.
- The *roof garden* is a social space, a peaceful place with plants and landscape views, as well as an opportunity to grow food communally.

Taken together, these spaces do a lot of the work that extra private square metres would otherwise have to do — which is part of what makes the compact apartments viable and the overall project affordable without feeling sparse.

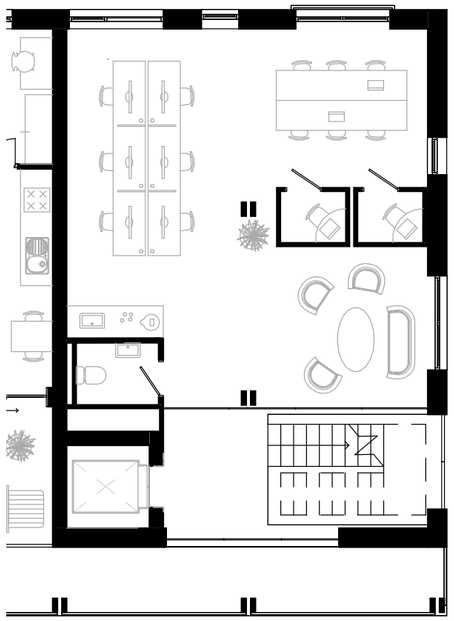


7. Luxury Reinvented
B. Shared Spaces

The library of things
level 01



Co-working space
level 02



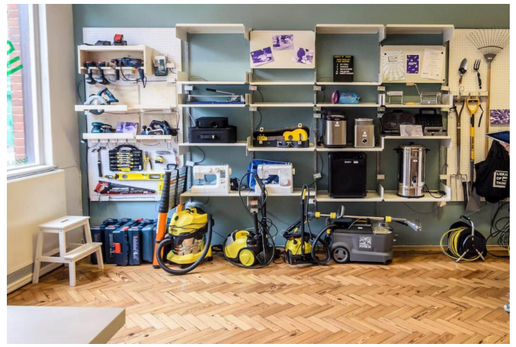
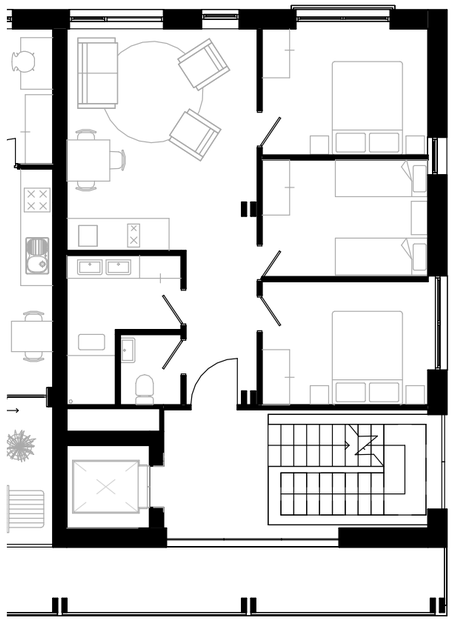


Figure 85. Library of Things. Photo by Dylan Lowe via positive. news

Figure 86. Shared space in the Kalkbreite Complex. Photo: archdaily.com

7. Luxury Reinvented
B. Shared Spaces

Guest bedrooms
level 03



The big hosting kitchen
level 04

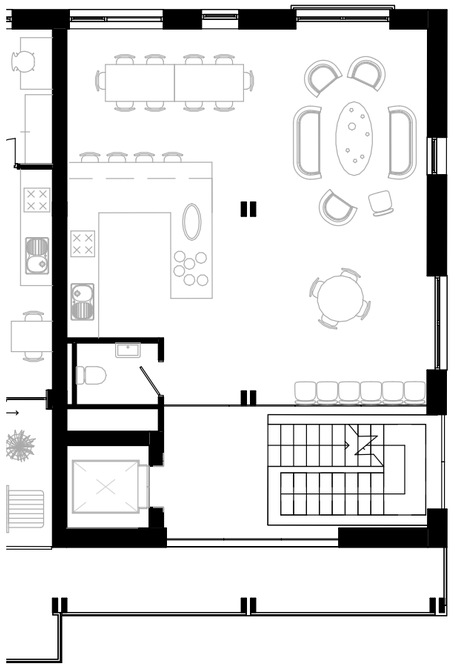
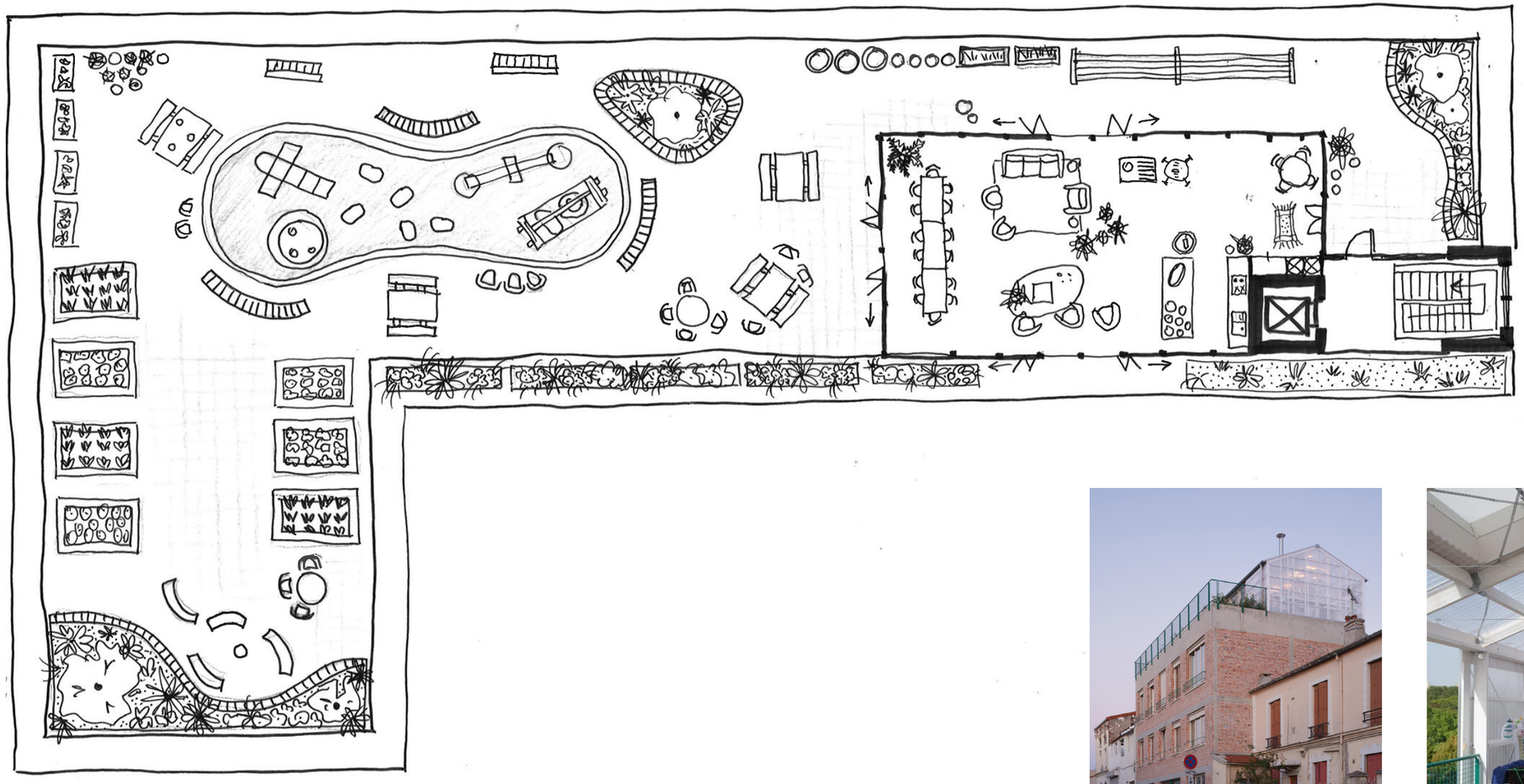


Figure 87. Guest bedroom at the Vindmøllebakken, Norway

Figure 88. Eating together at the Vindmøllebakken, Norway

Roof garden

level 05



7. Luxury Reinvented
B. Shared Spaces

Figure 91. DakAkker, Rotterdam

Figure 89. Maison Commune, Pantin, by Plan Común

Figure 90. Maison Commune, Pantin, by Plan Común

8. Day in the Life

These collages explore what radical sharing means in practice, every day, for residents, workers, and surrounding people.

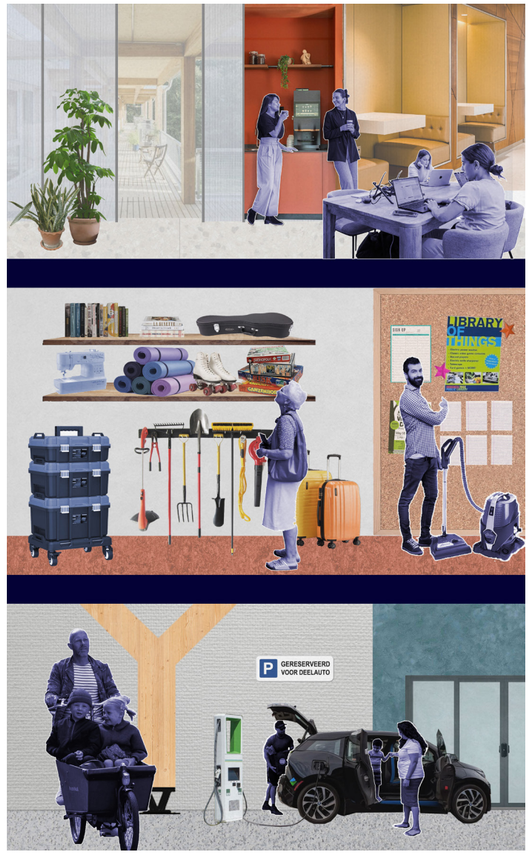
8:00

You are in your winter garden, half inside, half outside. Maybe you are trying to get your child ready for school, or exercising in the cool morning air. Downstairs, the first deliveries arrive at the cafeteria. The neighbourhood is waking up; someone crosses the courtyard on their way to work.

12:00

A FOX employee takes a lunch break, picks up a fresh meal from the cafeteria, and joins residents on the podium. Some sit in the sun overlooking the polder landscape and the rhythm of trucks arriving and departing. Others head out together for a run.

8. Day in the Life



17:00

You close your laptop after a day in the co-working space and stay for one last coffee with your neighbours. You've been meaning to clean your carpet, so you stop by the library of things to borrow a carpet cleaner. Below the podium, parents return the shared cargo bikes they used for the school run.

21:00

A birthday celebration is underway. The hosting kitchen is booked, a barbecue is taking place on the rooftop, and friends gather in the greenhouse as the sun sets. Guests visiting from out of town will spend the night in the shared guest rooms.


photographer: Sie Works

Part 4

Conclusion & Discussion

1. Conclusion

2. Implications & Recommendations

3. Reflection

Conclusion & Discussion

1. Conclusion

The research question asked how radical sharing can turn a mono-functional industrial site into a neighbourhood that is affordable, low-carbon, and worth living in. The design's answer is that the transformation is possible, but only if sharing is understood at full depth: the sharing of land, infrastructure, space, and daily life.

While my early research on dwellings focused on compactness and efficiency (smaller homes and more shared resources lead to less material waste), through precedent research and engaging with Brysch's (2024) thesis, it became clear to me that compact living alone is not a strong enough argument. The more radical argument I came to was that our comfort standards for housing can be redefined. The project's contribution is a model for what affordable luxury could look like: not looking at just the sizes of apartments, but at a rich sequence of spaces: from the private rooms, to winter gardens, to shared facilities, across the podium, and out to the polder landscape.

The 3 sub-questions also each find an answer in the design.

1. How can housing and industry share a site without one displacing the other?

This is addressed at two scales. The group masterplan works with the existing warehouses, keeping productive functions in place while adding housing, public space, and shared infrastructure. The governance model (see p.48-49) makes non-speculative housing possible on privately owned industrial land. This is a spatial argument too: we can rethink what counts as a good housing site, if the organisational structure is flexible enough to unite actors who do not usually work together.

At the building scale, the bridge connecting the residential blocks to FOX headquarters is a symbol for the coexistence of living and working. The residents and business mutually benefit and meet each other in the cafeteria and on the podium, where views onto FOX's truck yard celebrate the site's identity.

2. How can design redefine comfort while using less space, material, and energy?

Every apartment is extended by a winter garden: an unheated buffer space that is neither inside nor outside. The winter gardens are a passive energy strategy, a spatial amenity, and an architectural position. In line with Lacaton and Vassal's work, they transform the perceived space of the apartments without adding heated volume, mitigate noise and temperature, and sit between the private home and the social life of the gallery.

3. Can shared living build community while supporting affordability and ecological goals?

This is answered through the collective programme: a kitchen large enough for hosting big dinners, guest bedrooms and a co-working space that mean not every flat needs an extra room, a roof garden that allows for collective food growing, and a library of things that facilitates sharing of appliances. These shared amenities reduce emissions and challenge the line between private and shared life.

Conclusion & Discussion

2. Implications & Recommendations

The most important implication of this project is that industrial land should be included in housing discussions. The Netherlands has large areas of business parks and logistics zones at the edges of major cities. These sites are already urbanised and serviced and yet they are rarely present in housing policy discussions. This project demonstrates that the spatial challenges of mixed-use neighbourhoods (noise, scale contrasts, logistics) are not insurmountable, but have architectural solutions. Testing and documenting those solutions is a contribution that the architectural discipline can make to the wider policy conversations around housing and land use.

The governance model proposed further tests this idea. The partnership and shared governance between a private landowner, public institutions, and a housing community sits between the existing models of fully community-owned CLTs and conventional developer or housing association models. I argue that this partnership structure is particularly suited to industrial sites, where a business would like to diversify its income and improve its immediate environment without completely becoming a housing developer. For municipalities and housing associations this is a practical solution to unlock sites that the current policy overlooks.

At an architectural scale, the winter gardens, paired with a reduced private area and a generous shared programme, are a model for affordable and sustainable housing that isn't only about austerity. In line with Brysch's (2024) argument, this project argues that comfort is not private floor area alone, but about the spatial gradient of spaces and about collective provision. This is an alternative to both the speculative luxury apartment and the stripped-down social unit.

Lastly, the circular construction logic of the project aligns with emerging calls to action in the built environment. Not only is it a climate imperative for us to build circular, but buildings that can be adapted, repaired, and disassembled without significant waste are cheaper over their full lifespan. The regular timber column-and-beam structure, dry construction CLT cassette floors, and circular finishes are long-term investments for flexibility and easy maintenance. In the context of affordable housing in an unconventional setting, this kind of flexibility is also a safer financial option. The demountable parking structure shows the same logic, but with car infrastructure, which is expected to become redundant as car ownership declines.

Conclusion & Discussion

3. Relfection

This project changed how I understand affordability and collective housing. At the start, I aimed to design compact and efficient housing, but I became increasingly critical of the idea that affordability should primarily rely on reducing space. Affordability turned out to be a design principle that ran through every decision: from the tenure and land lease, to the section of the cassette floor. That shift is one of the most valuable things I took from this process.

I also spent considerable time reading about governance and housing policy, which broadened my understanding of what architectural practice can involve. It introduced me to academics and organisations working on alternative housing models in the Netherlands, and made clear that the spatial and organisational questions in a project like this cannot really be separated. The spatial gradient from private to collective to public only makes sense if the shared spaces are genuinely maintained and accessible. This requires a governance structure that treats them as common infrastructure.

The group masterplan contributed a lot to my ideas. The toolbox approach was a useful framework for a speculative project at this scale. The masterplan was also where the symbiosis between residential and industrial uses was first sketched as a principle, which I then developed through the partnership governance model.

Methodologically, the project reinforced for me how much design itself is a research tool, or at least that designing prompts new lines of questioning, that I then went and researched. Many of the strongest ideas only became clear once I was already drawing and modelling. Testing the relationship between a 30m² studio, a 12m² winter garden, and a shared gallery in plan and section made clear that the winter garden was not simply an addition to a small flat but a transformation of it, an argument that became central to my whole project. Looking back, I regret not starting the design phase earlier. The division between the first quarter's group research, hurried masterplan, and second quarter individual design felt too rigid. My best ideas happened when I was already drawing and designing, and came back to the first quarter's research, but from another angle. For example, in Q1 I read a lot of academic texts on affordability, but Brysch's paper, which encompasses so many of my ideas, only came about much later after I had designed my building forms and basic programme.

One aspect I did not have time to resolve fully is how the shift from a mono-functional logistics area to mixed-use community would be protected and governed over time. The partnership model creates the conditions for housing to be built, but the design assumes there would be a degree of social coherence that in reality would take years to develop and cannot be "designed". That gap between a spatial proposal and a social reality is perhaps the most honest thing the project has to say: architecture can create the conditions for a better kind of urban life, but it cannot guarantee them.

Nonetheless, I am proud of what this graduation project stands for. It is not a utopian vision but a practical one: housing that is straightforward to build, honest about its context, and designed to last. It argues that living closer together, sharing more, and finding collaborative solutions between unlikely partners are not compromises, they are simply a better more sensible way to live.

Appendices

1. Bibliography

2. Appendices.

A. Material & Elevation Research

B. Productive Spaces & Work-Live Units

C. Ground and First Floors

D. FOX Global Logistics

E. Case Studies: Living Smaller, Sharing More

F. Case Studies: Circulation

G. Form Development

H. Apartment Layout work in progess

I. Rodenrijs Polder Research

J. Innovative, Integrated Industrial Parks

K. Elevation Design

L. Cladding Research

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A. Materials & Elevation Research

Context Inspiration

Photos taken during a site visit.

corten steel

tramstationschipluiden.nl

gabion walls

colour panelling

colour accents

translucency

corrugated metals, and lots of grey!

Midden Delfland

A. Materials & Elevation Research

Case Studies: Using Colour

All these buildngs are white, but with strong accents of colour that I find very joyful. Maybe too much white looks like àhospital. But in Dr. prevost Housing, the colours serve a purpose, they mark the ground floor and the circulation.

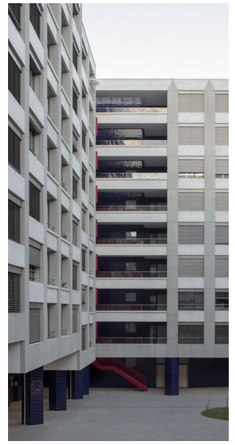


Figure 92. Dr.Prevost Housing, by Nomos Architects, Geneva.

Figure 94. WOHNEN KAISER FRIEDRICH STRASSE, by &MICA, Berlin.

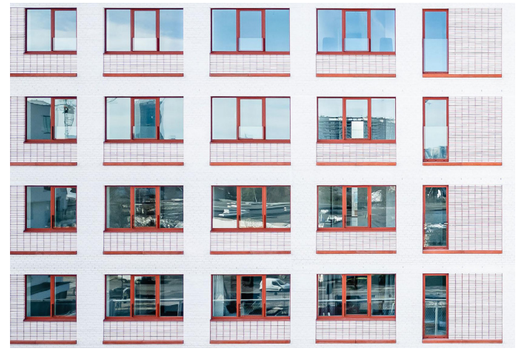
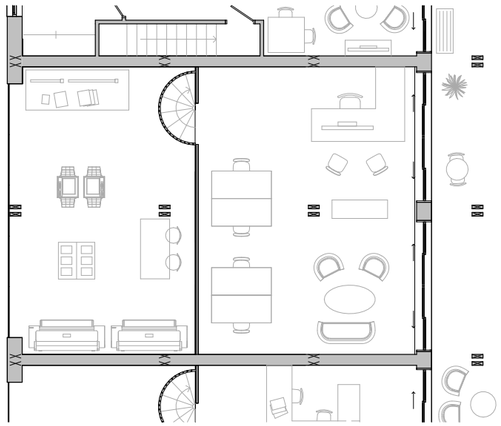
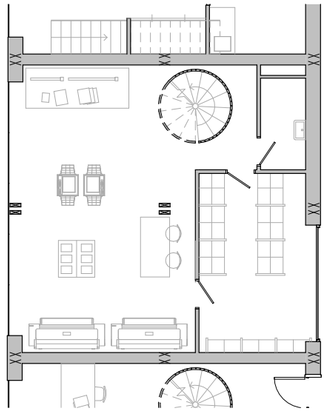


Figure 93. City Dox 7.1 / 7.2, by B architecten, Brussels.

B. Productive Spaces & Work-Live Units

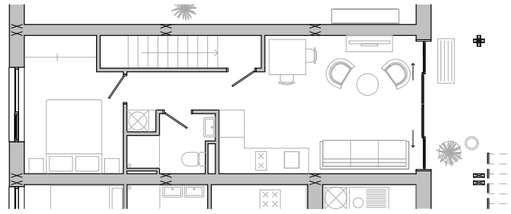


level 00

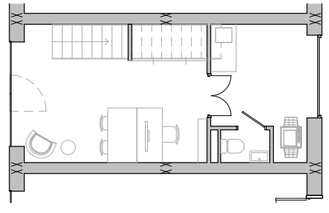


level 01

Printing Company



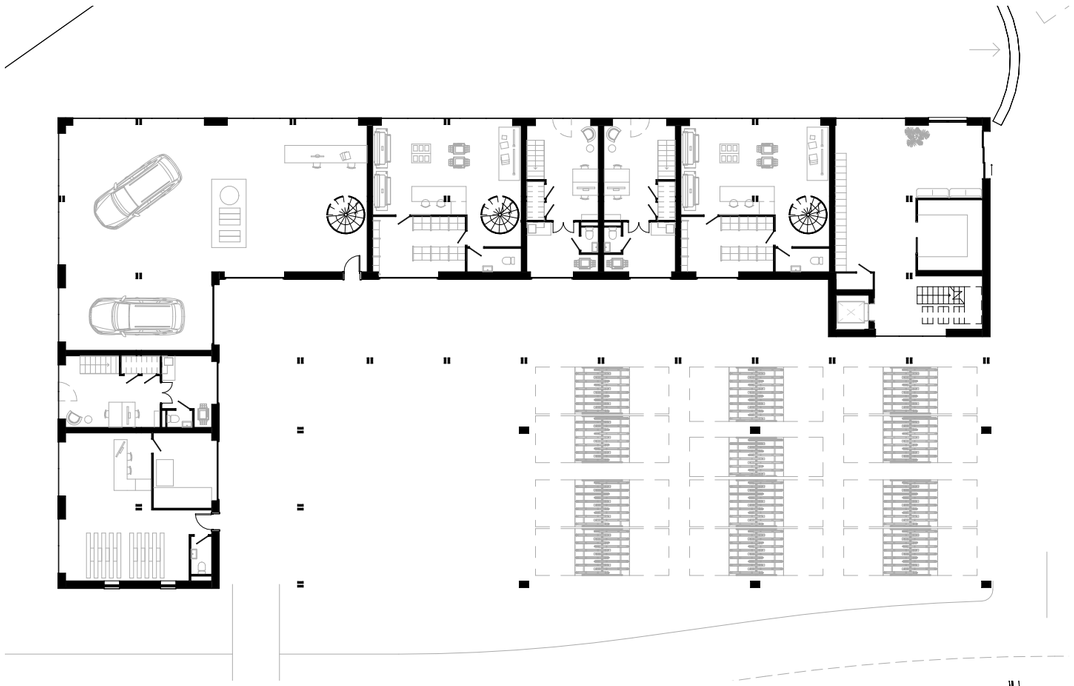
level 00

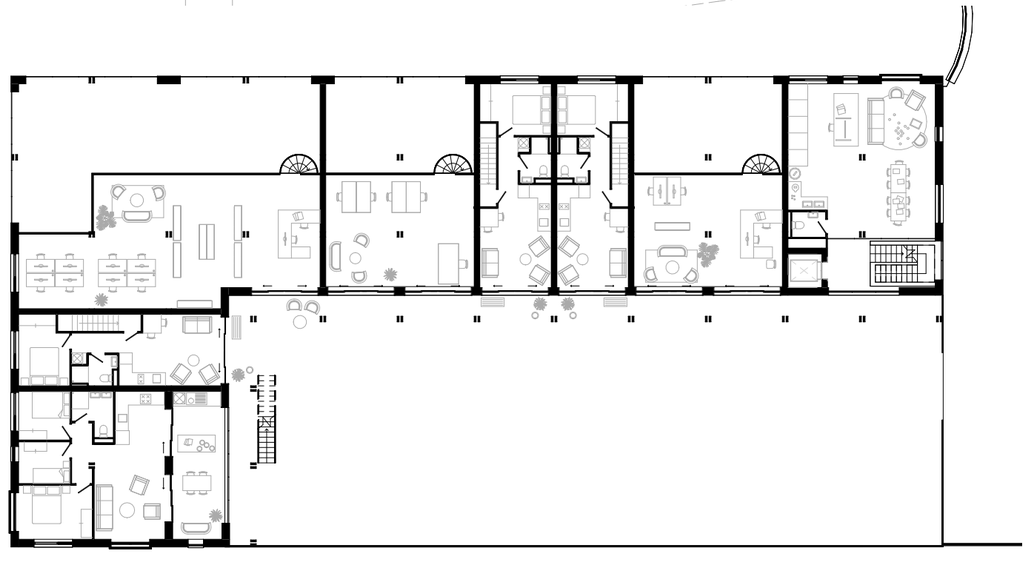


level 01

Work-Live unit

C. Ground and First Floor Plan





D. FOX Global Logistics

Business Identity of FOX Global

- “Global reach, local touch”
- Offices in Rotterdam port, Berkel & Rodenrijs, Shanghai, Schenzen, Bangaldesh
- Specialized in difficult products like lithium batteries, pVs, and renewables
- Push for innovation, interest in talent in IT and smart processes
- Careers page advertises 3 qualities: strategic location in Rotterdam,
- Diversity & Inclusion, Open & Loyal
- Job offers for drivers (day shifts & weekend availabilities, overtime, stages, and douanes process

MISSION AND VISION

Mission

For our customers: To provide new value to our customers by offering high quality logistic services & pursuing client satisfaction.

For our employees: To provide meaningful work, fair opportunities and create a motivating environment.

Vision

Connecting people, businesses and communities to a better future through logistics.

WAREHOUSING →
E-COMMERCE FULFILLMENT →
FORWARDING →
TRANSPORT →
CUSTOMS →
CONTRACT LOGISTICS →

SUSTAINABLE ENERGY

All our warehouses are equipped with solar panels, prioritizing sustainable energy at the core of our operations.

100.000
Square metres of distribution space

89 #
Top 100 Logistics Service Provider

50 +
Countries where we operate

My email to Cem Eralp

Dear Cem,
My name is Mila, a Master’s Architecture student at TU Delft. For my graduation project, I’m researching how logistics areas and businesses like FOX Global Logistics at Bedrijvenpark Oudeland could share energy and facilities with housing developments, or invest in housing themselves, creating value for both businesses and municipalities, and potentially unlocking new sites if planning rules allowed mixed use. The project is fully speculative and for academic exploration purposes only.
To help me design a project with a convincing story, I’d greatly appreciate some rough information about how the site operates (ballpark answers are fine):
Are business operations 24/7 or mainly daytime?
Rough number of employees on site, and shift patterns?
Typical electricity use: steady consumption or peak hours?
How much demand is covered by your solar panels?
Any surplus energy or plans to expand the solar panels?
Do you own the entire shed on site?
Have you considered running your own data centre on site, or investing in independent data centres?
Do truck drivers (e.g. via Melle Transport or others) ever need short-stay accommodation near Berkel en Rodenrijs?
Any information will be used only for my graduation project and will not be publicly published.
Thanks very much for your time, and I’m happy to answer any questions if needed.
Kind regards,
Mila Giovacchini

D. FOX Global Logistics

Answers from Cem Eralp

- HQ office 60-70 employees
- warehouse in botnek around 50 people there
- china not counted
- yes they own the whole shed here
- they used to have operations themselves here, but now they rent out the whole shed to a client, this is used 24/7
- rent includes electric bills, not everything is covered by solar panels, still a bit more is charged

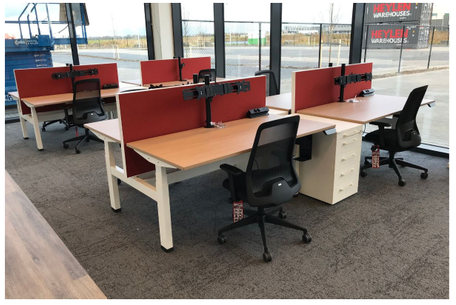
"Finding land like this in the regio of south of holland is very difficult and expensive... yeah.."

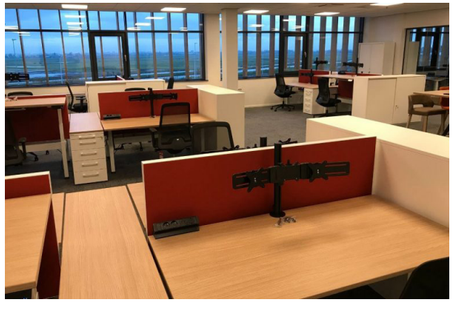
"Everything is cloud. So, no we don’t want physical data centers”

strange answer!
using “the cloud” consists of renting data centres from cloud companies. It doesn’t mean you are not using data centres at all.

Up "Uw projectinrichter"

Designed the offices





Maison Commune
Pantin, France
Completed: 2023
Architects: Plan Común
Dwelling units: 5 new + 1 renovated
Area: 340 sqm

Programme: shared glasshouse: kitchen and laundry, outdoors space, courtyard, bike storage

Notes: shared laundry, but I'm pretty sure everyone still has their won washing machine? at least the larger apartments do.

Shared Spaces, unheated
Private Dwellings, heated

Figure 95. Floor Plans of Maison Commune, by Plan Común

Figure 96. title

Figure 97. title

wij_land

Amsterdam, Netherlands
Completed: 2023
Architects: Space & Matter
Dwelling units: 26 apartments
Area: 2600 sqm
Programme: 5 shared spaces: collective garden, commercial space, guest room, rooftop terrace, adjoining orangery for gatherings.

Notes: Self commissioned and built. "The residents share as much as possible, such as tools, cars, food, cat care, and communal spaces. Sharing contributes to sustainability and connects residents with each other."

Figure 98. A wide corridor in the wij_land complex

Shared Spaces, unheated
Shared Spaces, heated
Private Dwellings, heated
Commercial Space, heated
Guest bedroom?

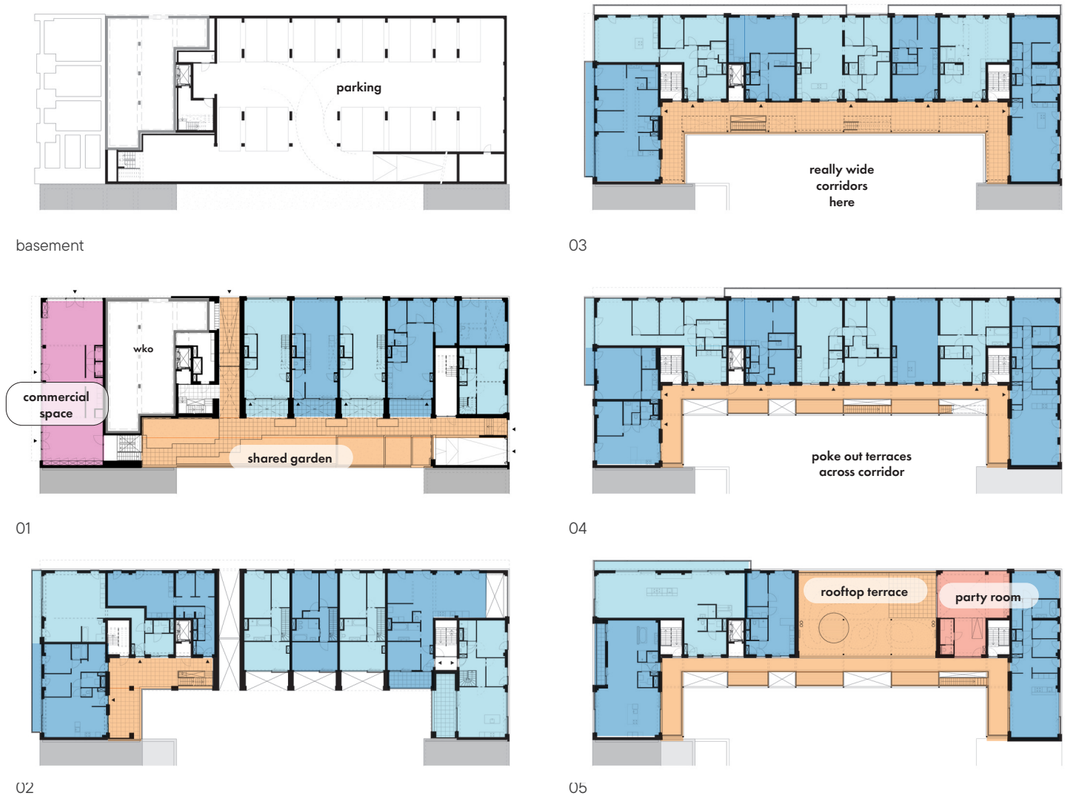


Figure 99. Floor Plans of wij_land, by Space & Matter

Narkomfin Buidling

Moscow, Russia

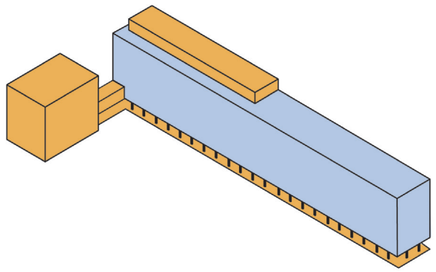
Completed: 1932

Architects: Moisei Ginzburg and Ignaty Milinis
Dwelling units: 54

Area: approximately 3,700 m²

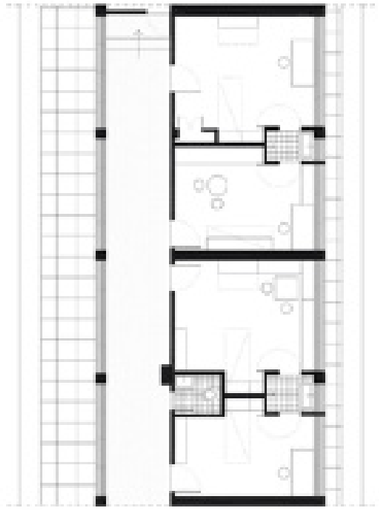
Programme: Designed as a transitional type between bourgeois family apartment and full collectivisation; duplex “F-type” units minimized private kitchens to push residents toward communal life

Notes: Commissioned by the Soviet government (Narkomfin – Commissariat of Finance) to house state employees; intended as a prototype for socialist living



Communal Spaces
Private Dwellings

The communal block includes kitchens, dining areas, bathrooms and recreational rooms



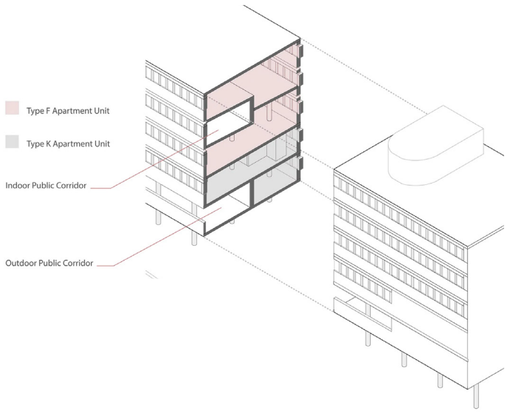
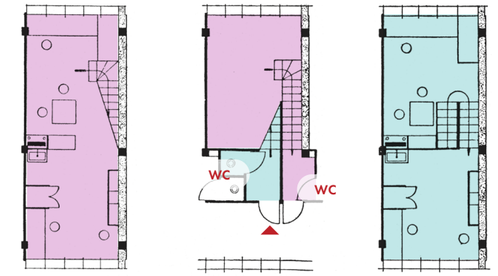
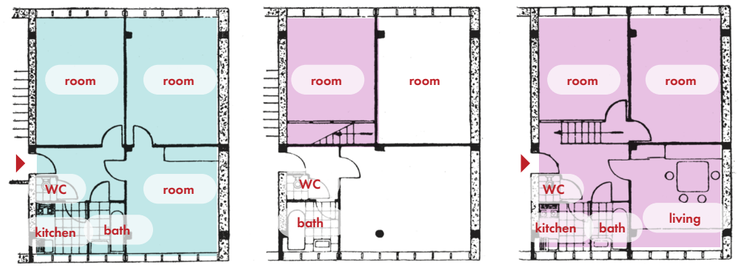


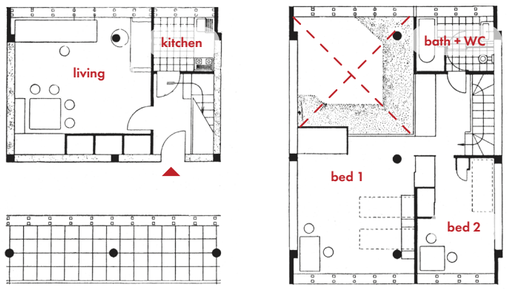
Figure 100. Type C experimental housing. Two rooms share a toilet and a bathroom



plans for type F apartments, third, fourth and fifth floors



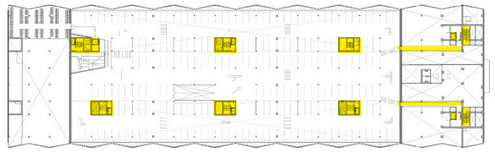
plans for type 2-F apartments, third, fourth and fifth floors



plans for type K apartments, first and second floors

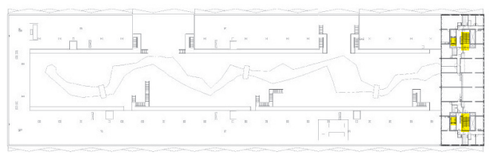
F. Case Studies: Circulation

Level 01



Level 02

Level 05



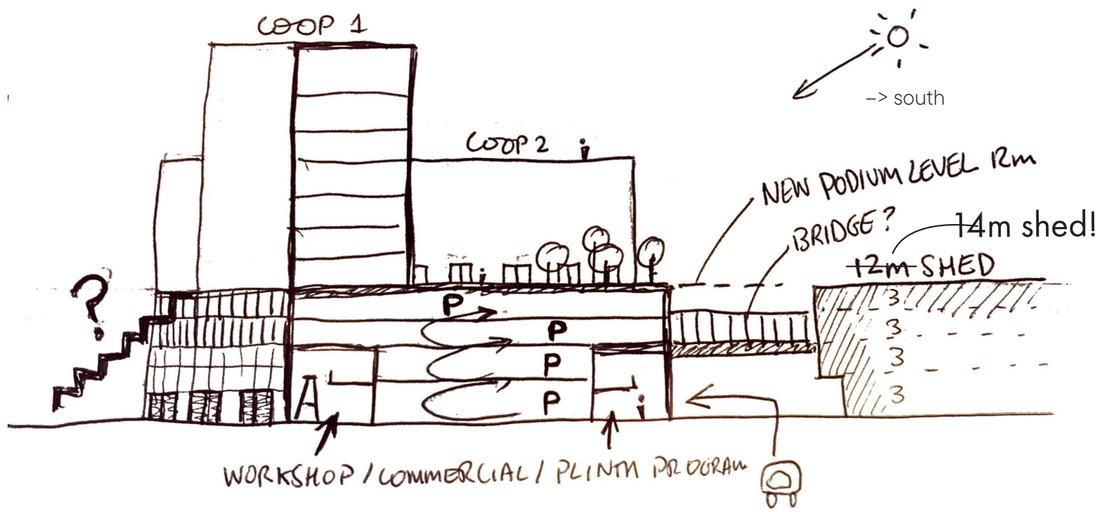
Level 07

housing	garden	housing
housing		
housing		
housing		
parking		
parking		
active plinth		

Figure 101. De Kameleon, 2012. Blijmermee, Netherlands. NL Architects

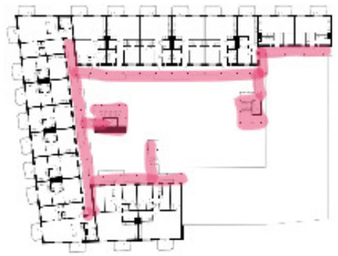
The Kameleon integrates parking on levels 2&3. I considered this but ended up not chosing it in the interest of flexibility and affordability. What to do with those levels if we no longer need this much aprking after?

F. Case Studies: Circulation

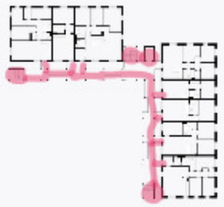


Design thought: podium level and parking underneath
- how to connect with the street?

Circulation for L shaped, gallery access building



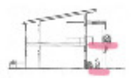
qvillestaden-apartment-building-bornstein-lyckefors



visible stairs up to the gallery

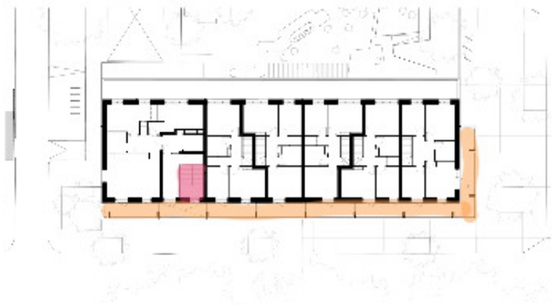
just a concrete block for the lift, nothing special

L shaped building is split in two and has circulation in the middle



i like the collonade

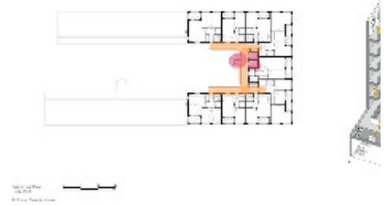
the stairs are on the inside, and in the facade on the straight side

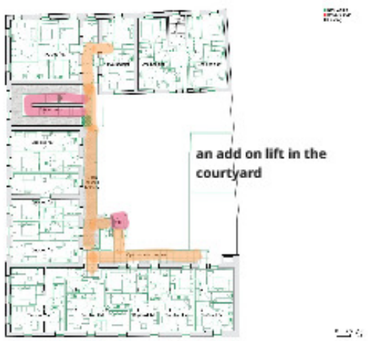


big wide flat columns that also serve as separators between each house, between spaces

appropriated as terrace space,
hanging laundry

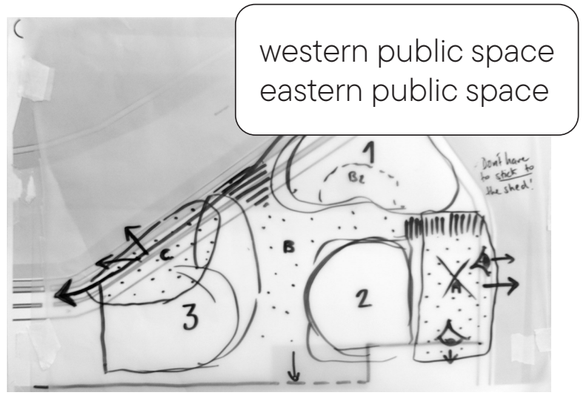
F. Case Studies: Circulation

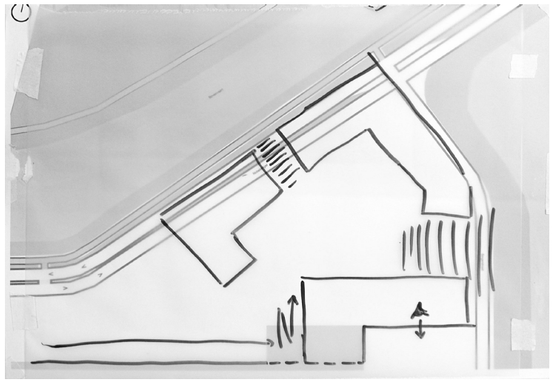


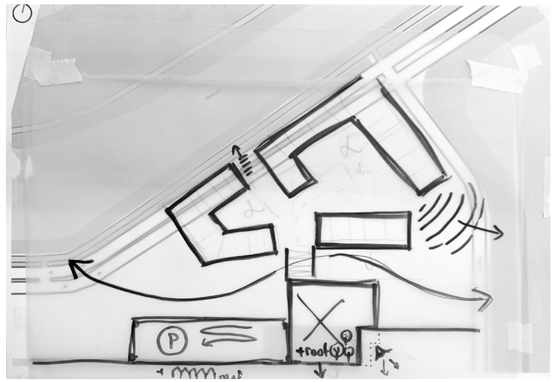


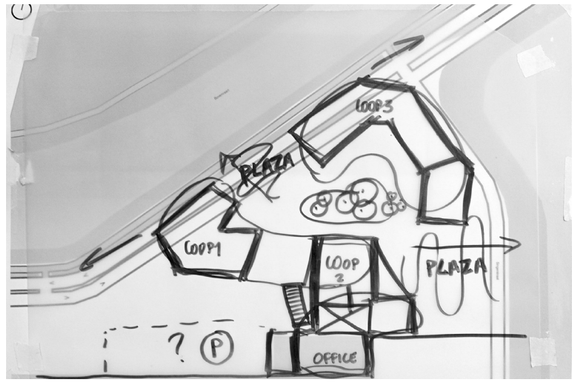
an add on lift in the courtyard

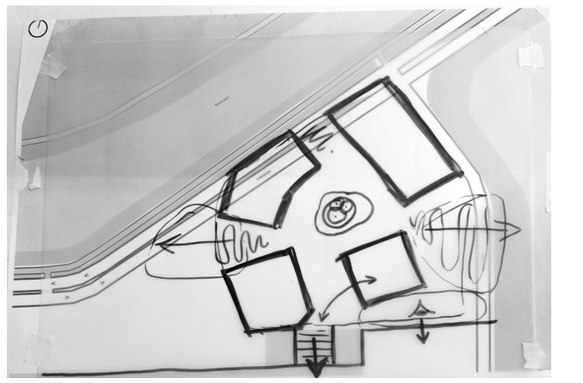
G. Form Development

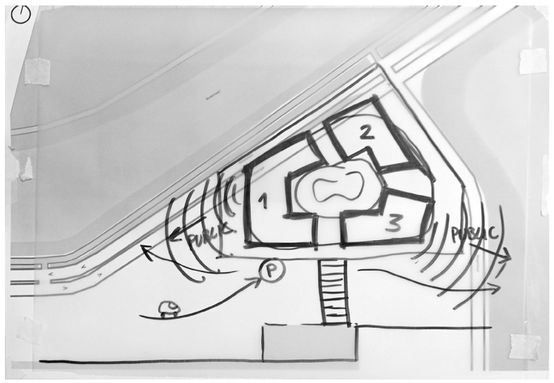


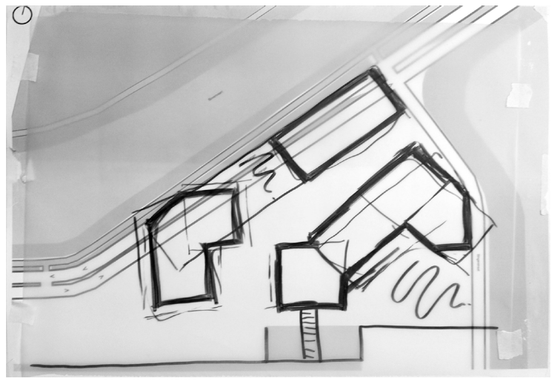


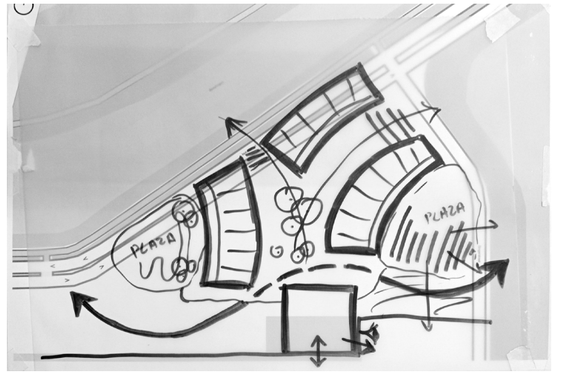






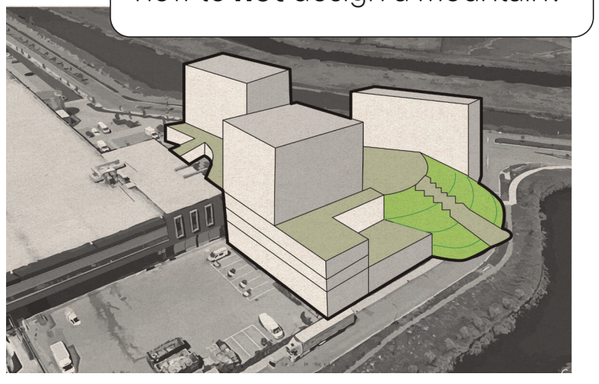






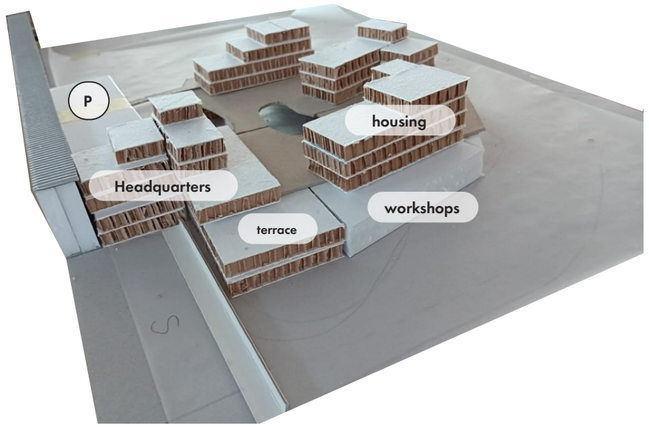
can the multi-storey parking and mixed-use building be separate?

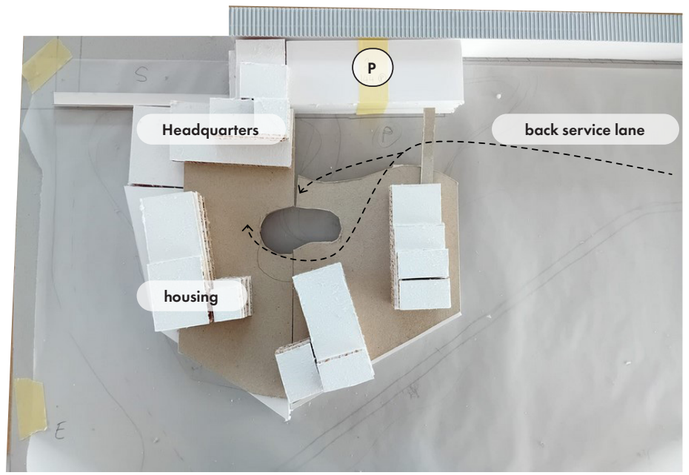
how to **not** design a mountain?



Sketches & Case Studies

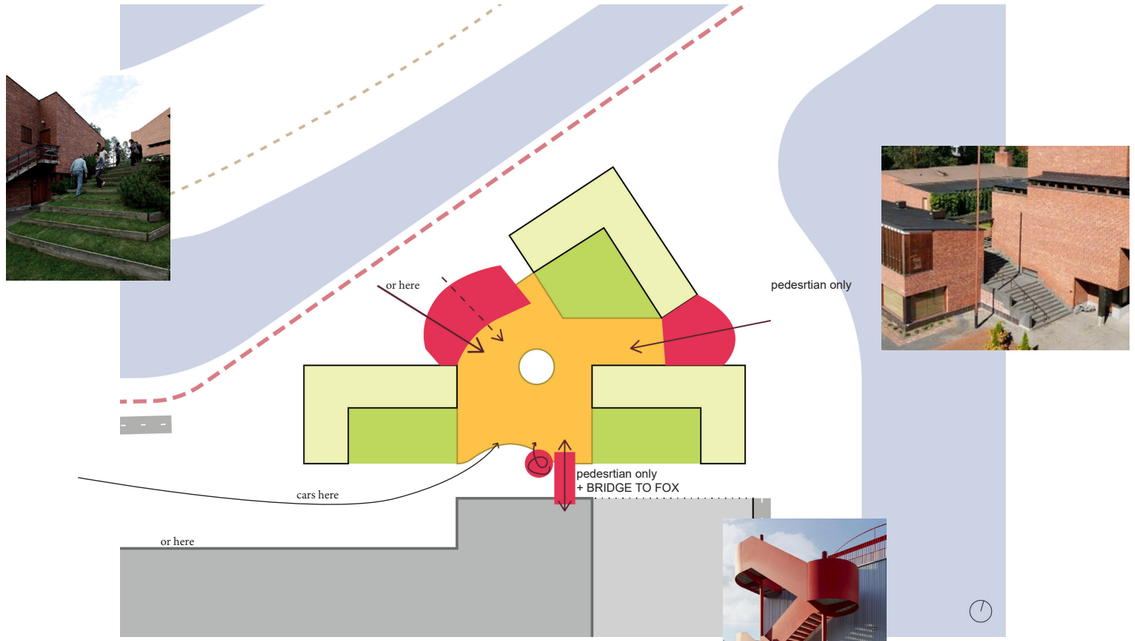
G. Form Development

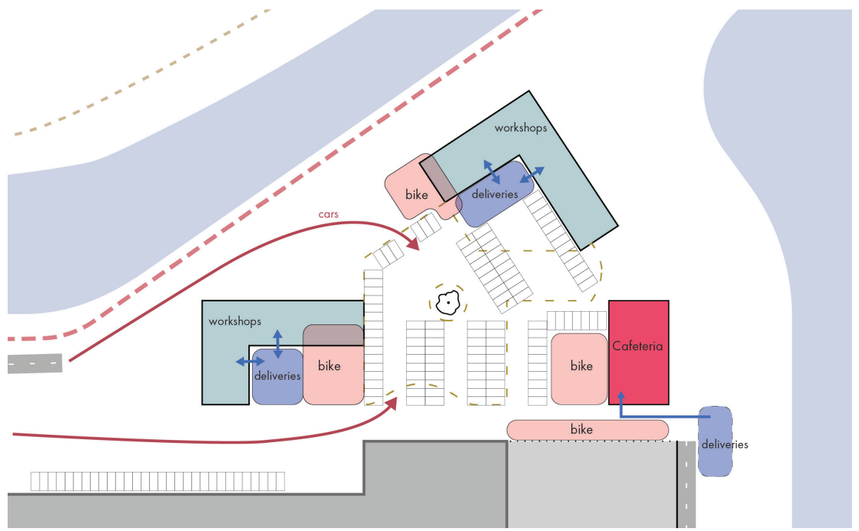




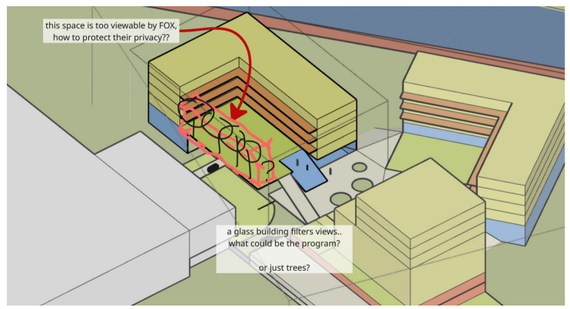
G. Form Development

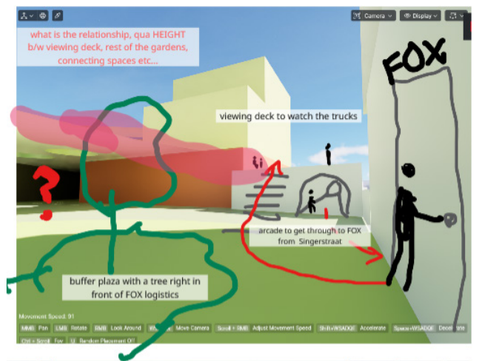
3 ways to access the podium level

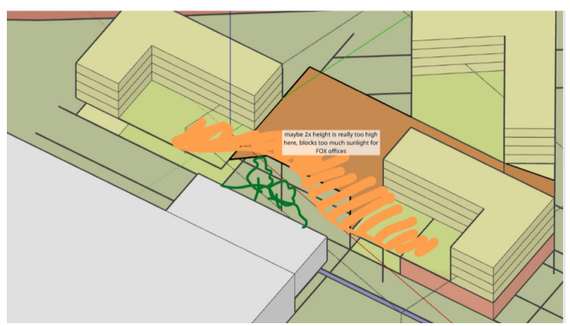


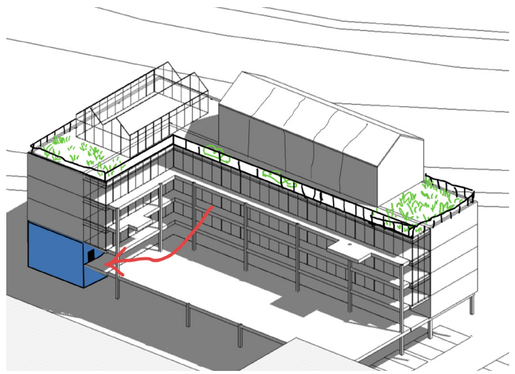


G. Form Development

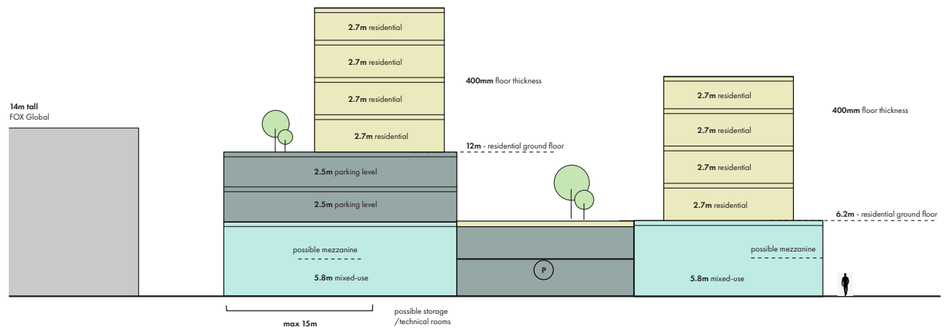


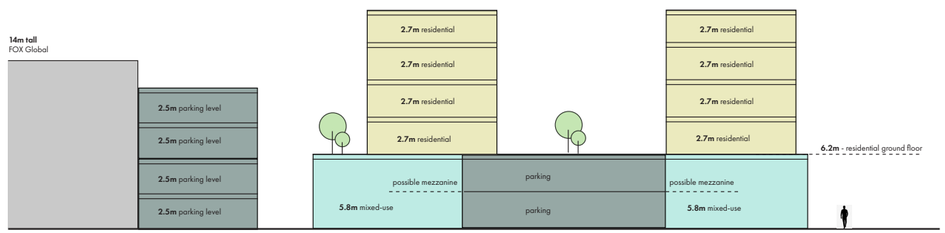


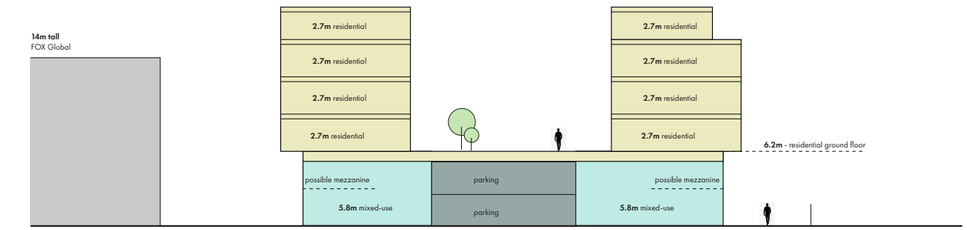


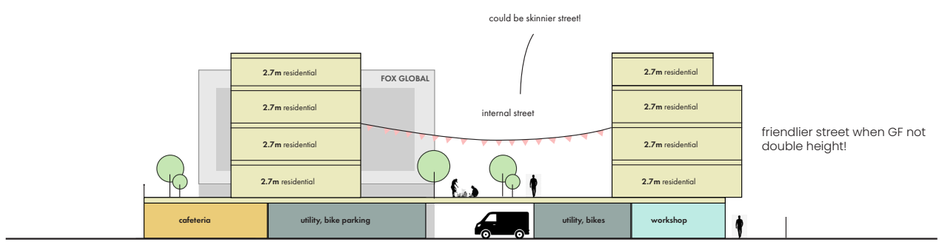


G. Form Development

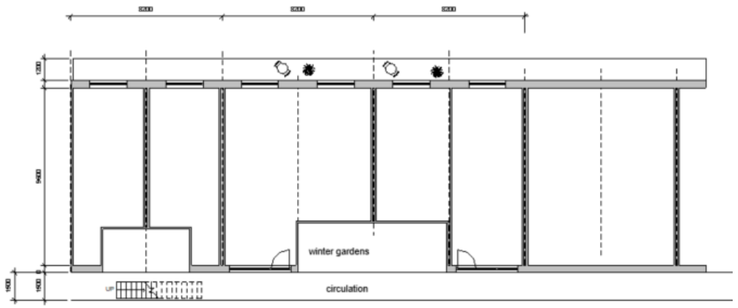


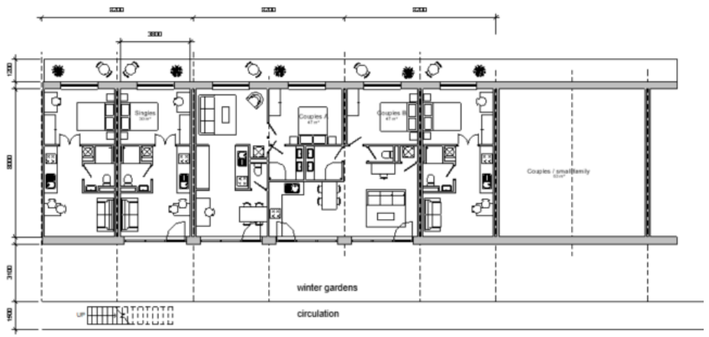


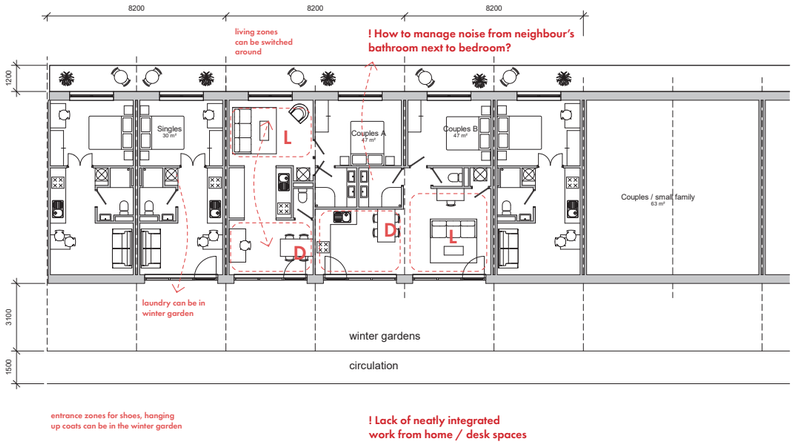




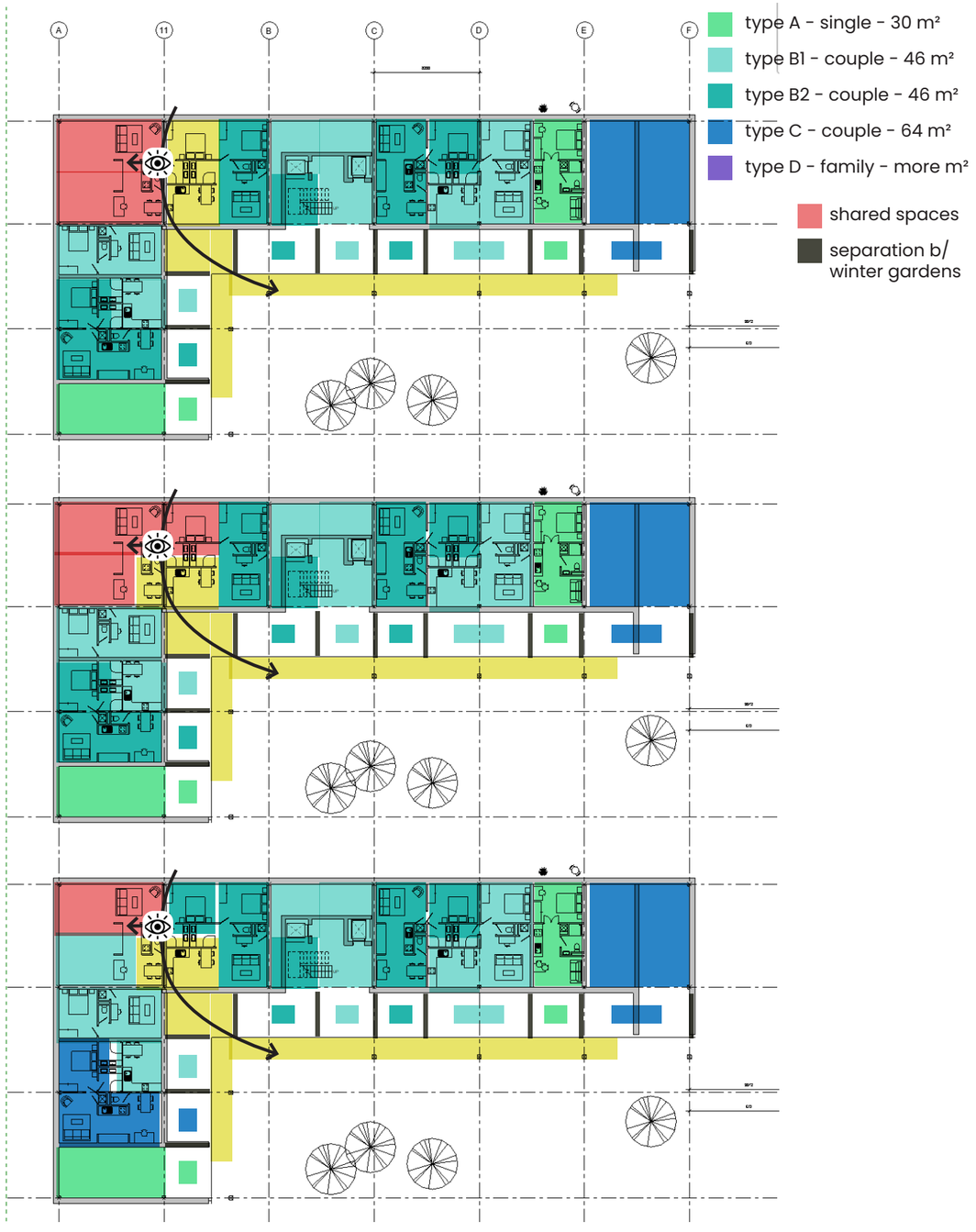
H. Apartment Layout Development



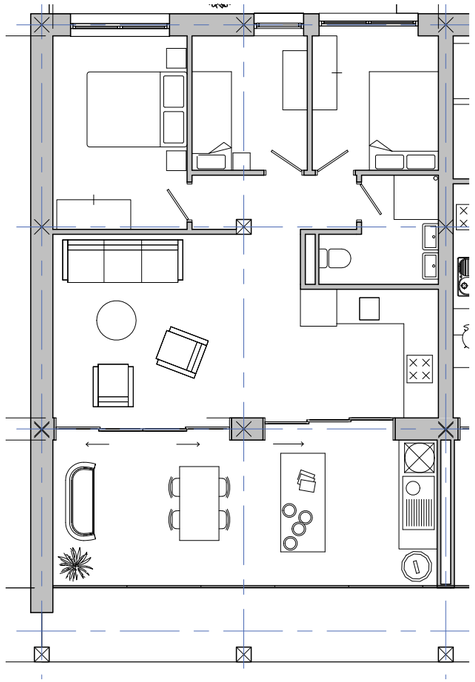


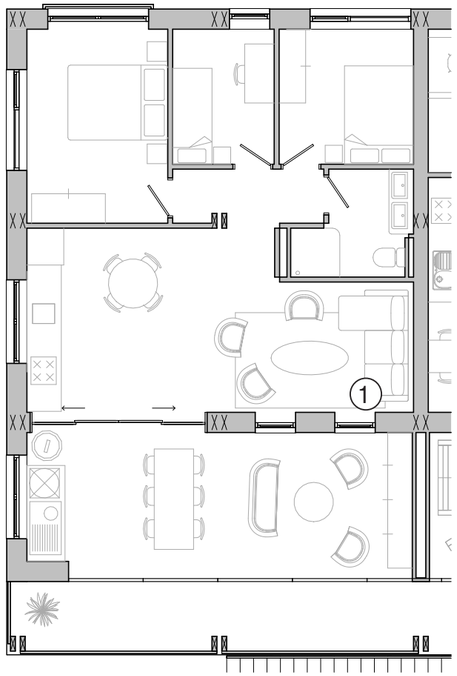


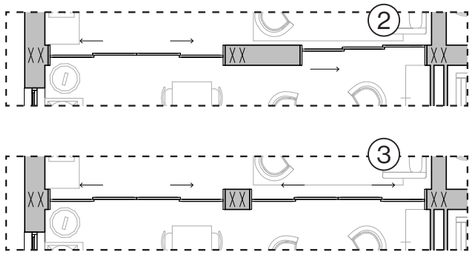
H. Apartment Layout Development



H. Apartment Layout Development







3 bed design: original

kitchen is in the smaller living zone

✓ living areas nicely extended into WG

✗ lacks dining table option in-doors

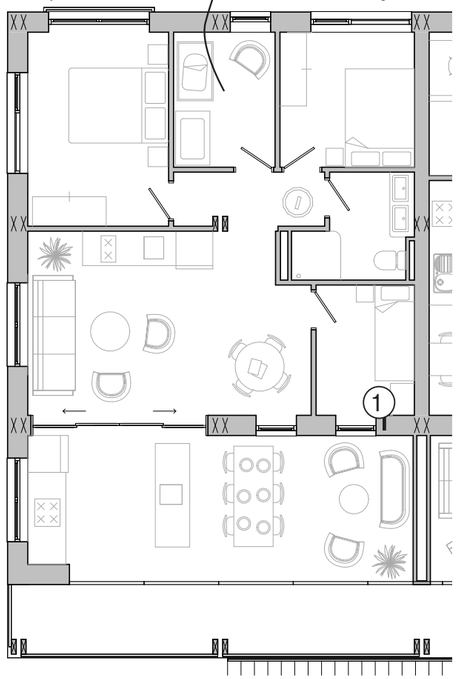
3 bed design: new

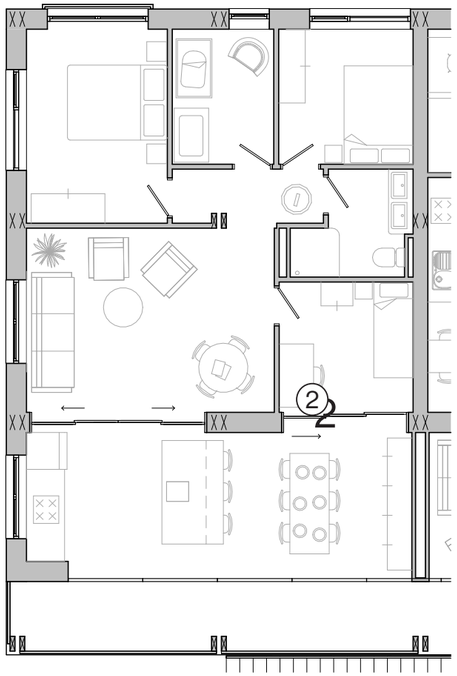
✓ dining/cooking zone extended by WG
✓ sitting zone extended by WG

? is it better to have:
1. fixed windows
2. smaller sliding door
3. larger sliding door + curtains

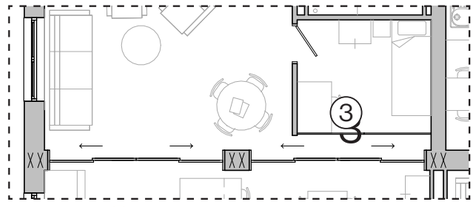
H. Apartment Layout Development

option to convert kid's room to baby room





? The 4th bedroom: set back or no set back?



? how to close this extra bedroom if I keep the large sliding door?

4 bedroom design: option 1

✓ minimum provision of sitting, dining, cooking indoors

✗ kitchen not logically extended to WG
living not logically extended to WG

✗ windows to bedroom don't allow much flexibility

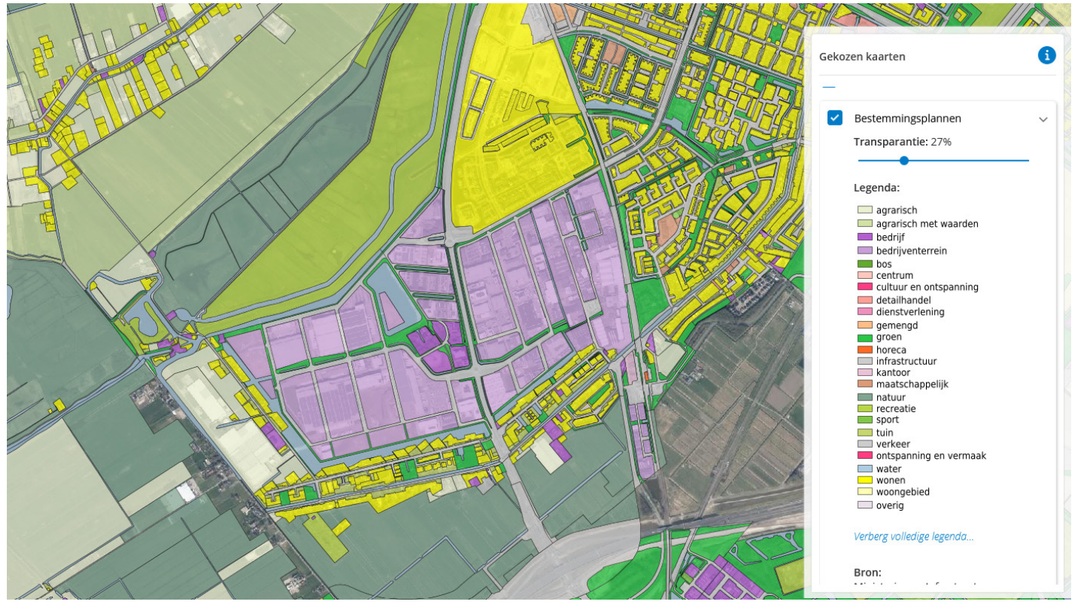
✗ set back of bedroom is a bit awkward

4 bedroom design: option 2

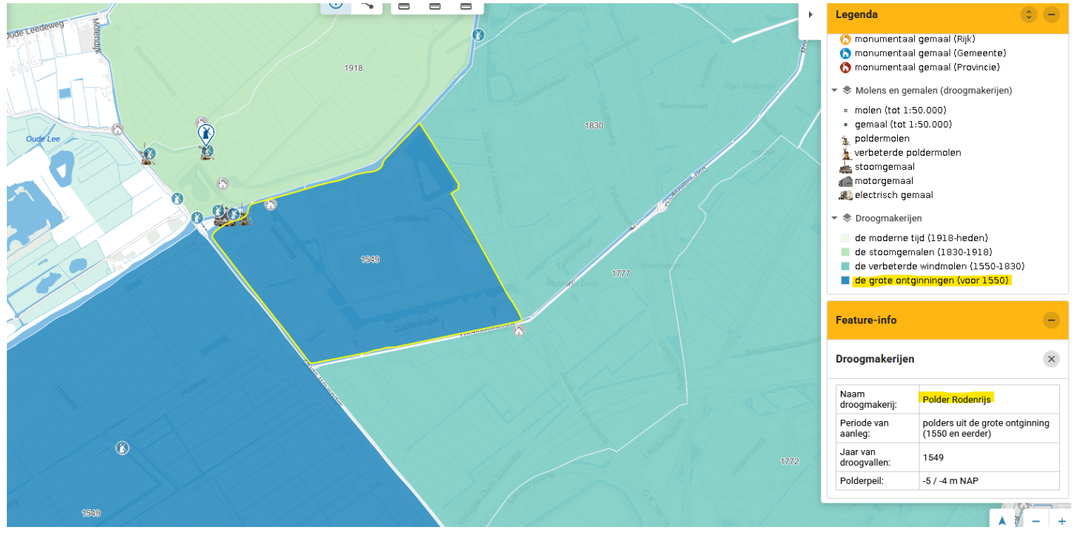
✓ more logical 4th bedroom, aligned wall

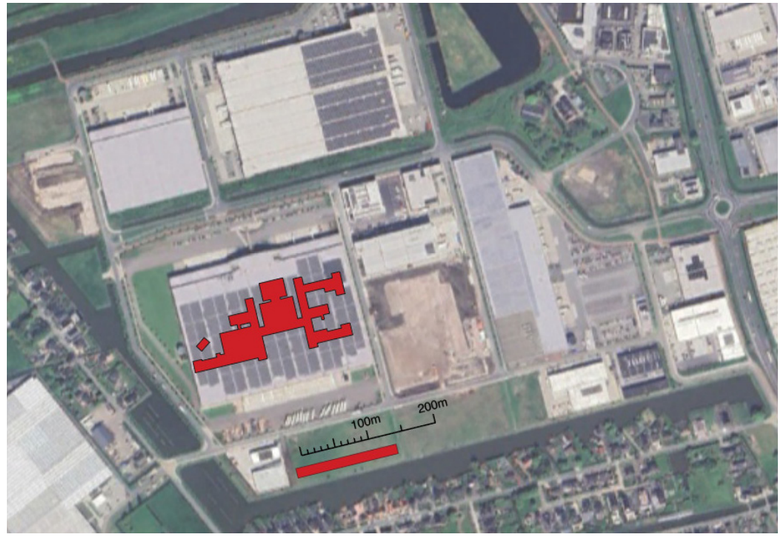
✗ no minial provision of cooking inside

I. Rodenrijs Polder Research



I. Rodenrijs Polder Research





J. Innovative, Integrated Industrial Parks

Kalundborg Eco-Industrial Park

Located in Denmark is a great example of industrial symbiosis.

Through unintended private initiatives emerged an exchange of goods between housing and industry. In the park is located the Asnaes Power station, a coal-fired power plant. Surplus heat from this power plant is used to heat 3500 local homes and a nearby fish farm. Steam from the power plant is sold to Novo Nordisk, a pharmaceutical and enzyme manufacturer. This reuse of heat reduces the amount of thermal pollution to a nearby fjord.

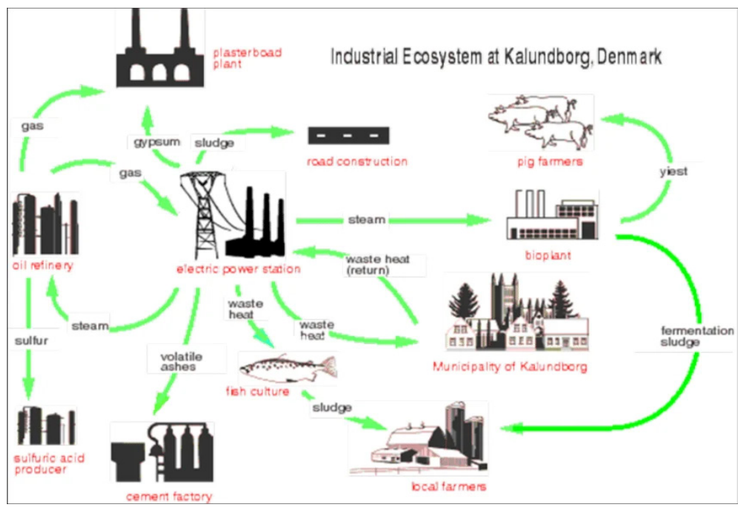
Hamerkwartier, Amsterdam

This is a project that is still in early phases, but it's a former industrial estate in the north of Amsterdam that is being transformed to a mixed-use district combining housing, working, learning, services and public life. Perfect example for our site. The planned program is roughly 2/3 housing and 1/3 work/industry.

It will become a 'creatieve productiewijk', with:

- repair and manufacturing workshops
- creative industrie
- production
- cafés, culture and services
- community services

all integrated in residential environment that will contain social, middle and private housing so area will be mixed.



J. Innovative, Integrated Industrial Parks

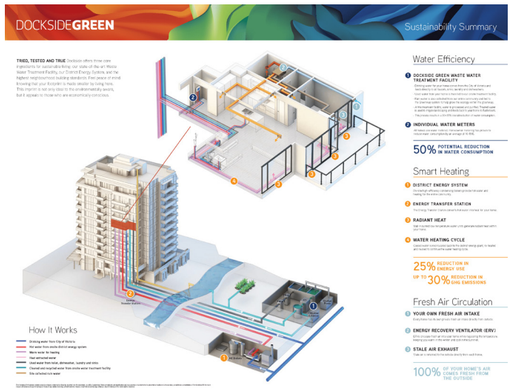
Dockside Green

(Victoria, Canada)

A redevelopment of former industrial land into a mixed-use neighborhood with housing, offices, and retail.

Centralized biomass plant provides renewable heat and energy for homes and commercial spaces.

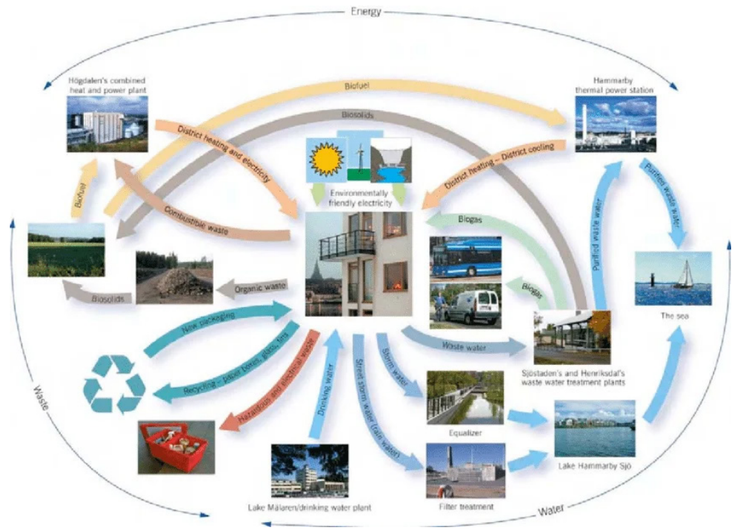
Water treatment systems reuse water for toilets and irrigation.



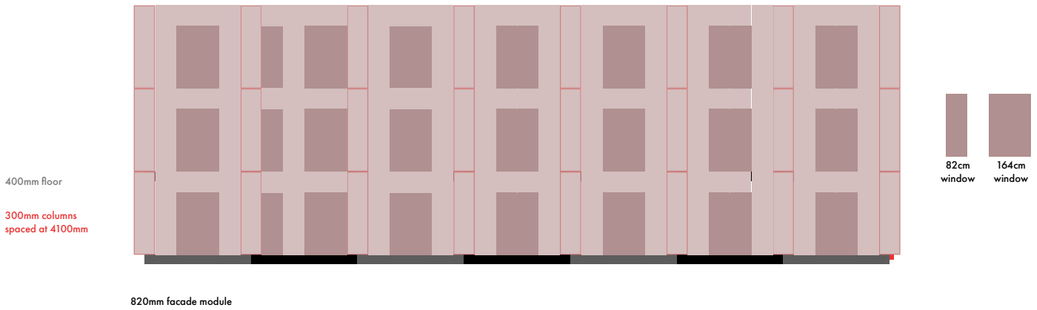
Hammarby Sjostad

Sweden

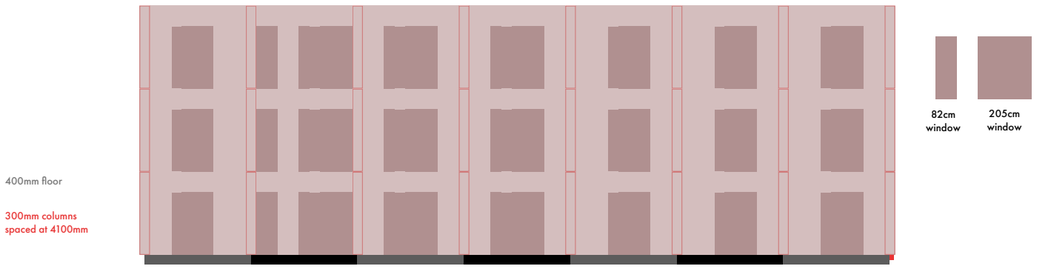
- Energy: solar cells + hydropower + bio fuel technology
- Solar panels on roof tops and solar cells cover facades, into electrical energy, used to heat hot water.
- combustible waste from the area recycled in the form of heat
- Sewage water is cleaned and purified at a large sewage plant just outside the area and the waste is then recycled into natural gas
- The waste water from a single household produces sufficient biogas for the household's gas cooker, and most of the biogas is currently used as fuel in eco-friendly cars and buses (city of Stockholm 2007).
- In addition, heat produced through this purification process is then recycled for use at a district-heating unit. Eventually the district heating will be delivered from a combined power and heating plant based on bio fuel technology (Cabe 2007). A "smart system" implemented in a few of the houses helps residents understand more about their energy use.



K. Elevation Design
Openings & facade rhythm

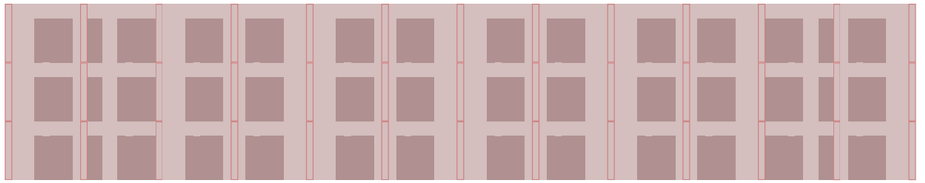


820mm facade module

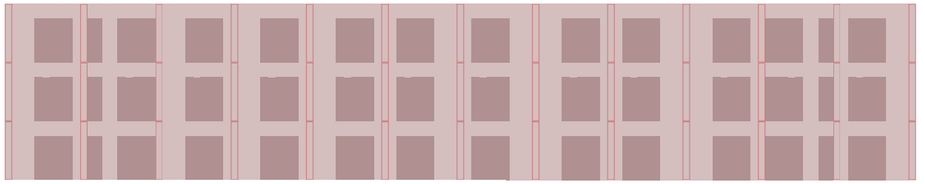


410mm facade module

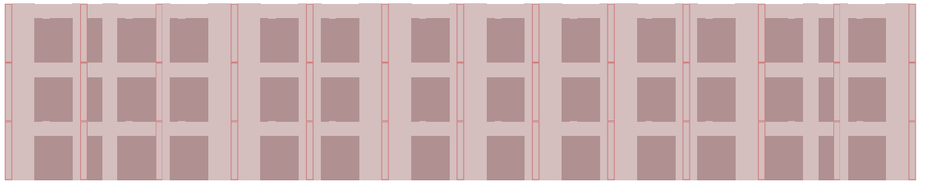
K. Elevation Design
Openings & facade rhythm



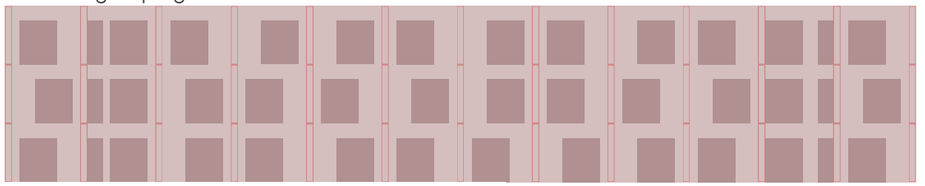
Grouping pairs.



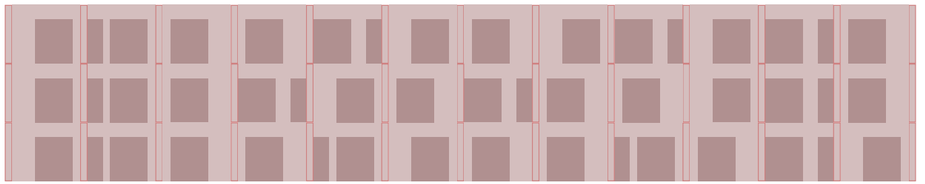
Different groupings.



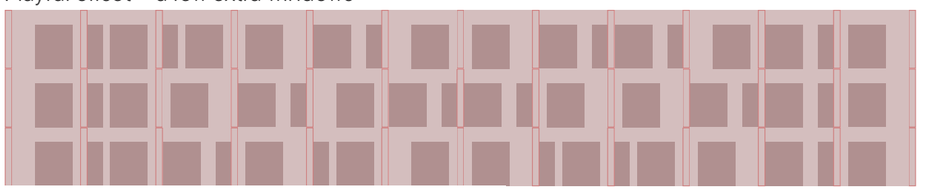
Different groupings.



Playful offset



Playful offset + a few extra windows

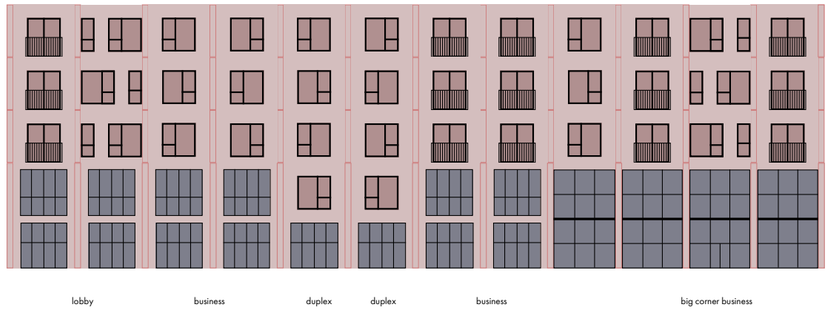


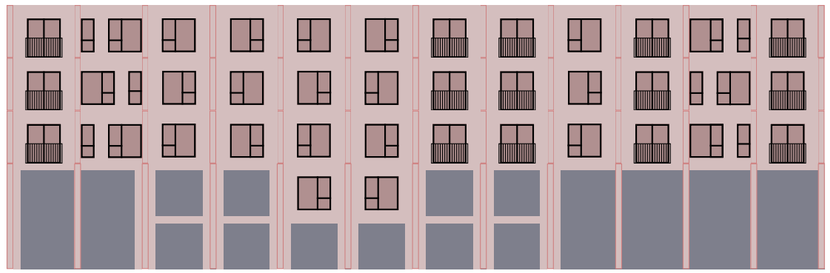
Bar code effect, with regular bookends

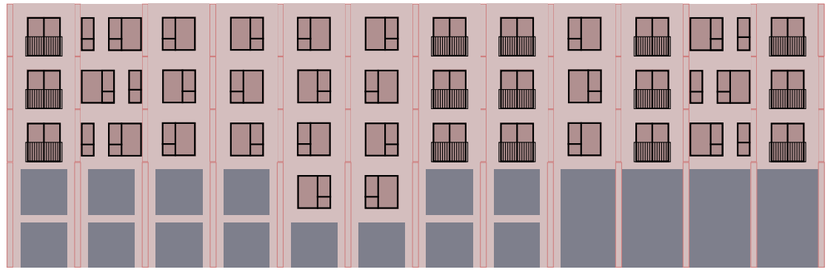
K. Elevation Design
Openings & facade rhythm

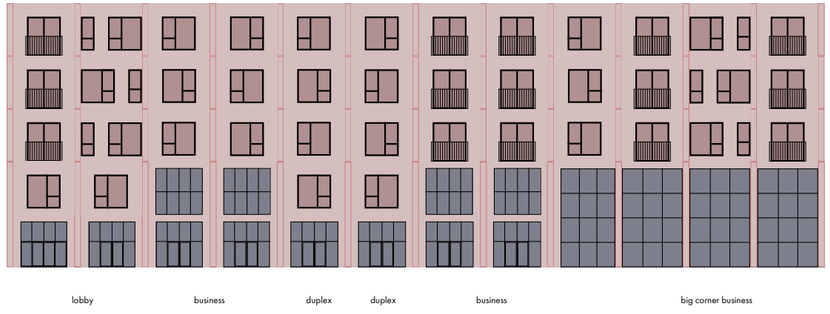
K. Elevation Design
Openings & facade rhythm

K. Elevation Design
Openings & facade rhythm

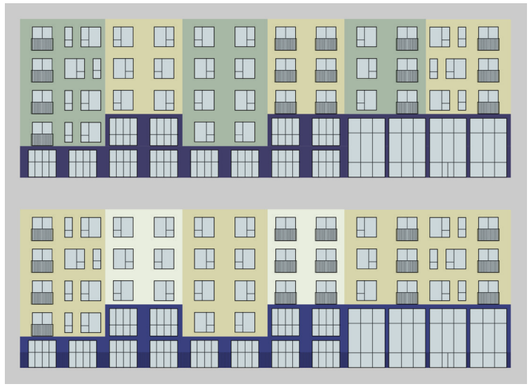








K. Elevation Design
Openings & facade rhythm



Create a base. Split the top vertically.

Human scale on the ground floor

Lighter cladding on top. Lobby in a brighter colour.

Single, wider lobby entrance?
Should we see the columns through large glazing?

Double height lobby?
Should we see the columns through large glazing?

blue / golden brown windows?

K. Elevation Design

No real elevation onto the courtyard.. only winter gardens

Concern: how to keep eyes on the courtyard when they are closed?
It could quickly look messy and

include timber pop out terraces to help or reduce the amount of covereage of winter gardens?

maybe an active ground (+1st floor) and an active roof then?

L. Cladding Research

KERLOC bio-based cladding

works great, I was very convinced by their brochure. But, it looks cheap without mortar joints..

fibre reinforced, cold-pressed ceramic material. residual materials, the material is biobased and fully recyclable. “Kerloc uses residual waste, including poplar wood that is cut down for the expansion of the road network in the Netherlands.”

Last more than 50 years.

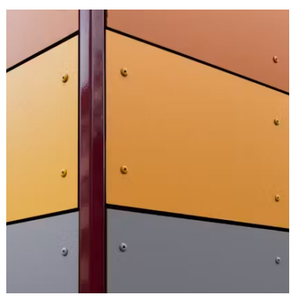
Circular: after use, the panels are taken back and ground into raw material for new Kerloc facade panels

standard size of 1500 mm x 100/450 mm, standard thickness of 10 mm

Fastening with stainless steel screws,with 12 mm head. The minimum depth of support structure is 25 mm. Distance from edge of panel to center of hole: 25 mm.

No performance or appearance loss long-term (humidity, sun, wind, frost)

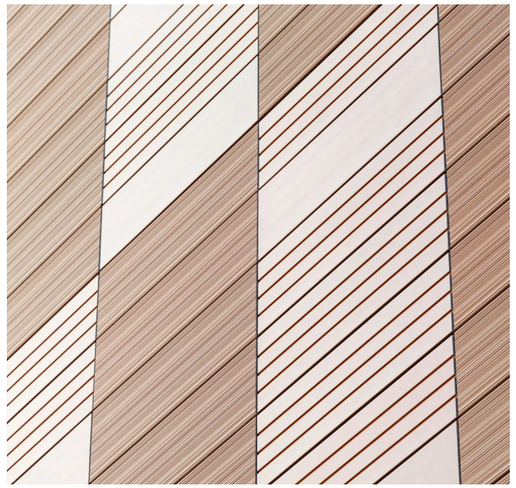
AGRO BUCHTAL ceramic cladding colour options



Rockpanel / Kerloc cladding.

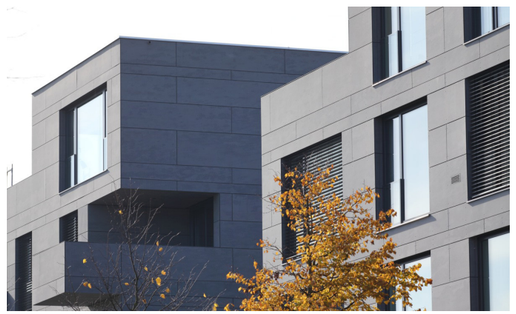
Look great from afar, but I find the joints and corners a bit ugly.

L. Cladding Research



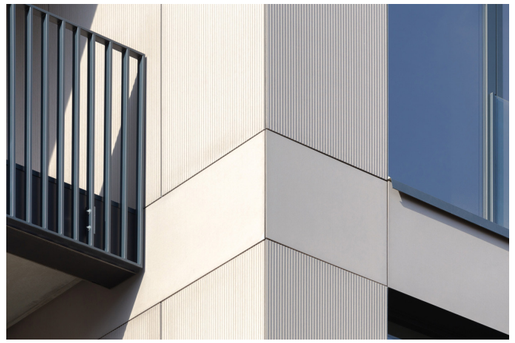
City Village, Coventry, by Simpson Haugh

Using AGRO BUCHTAL ceramic tiles



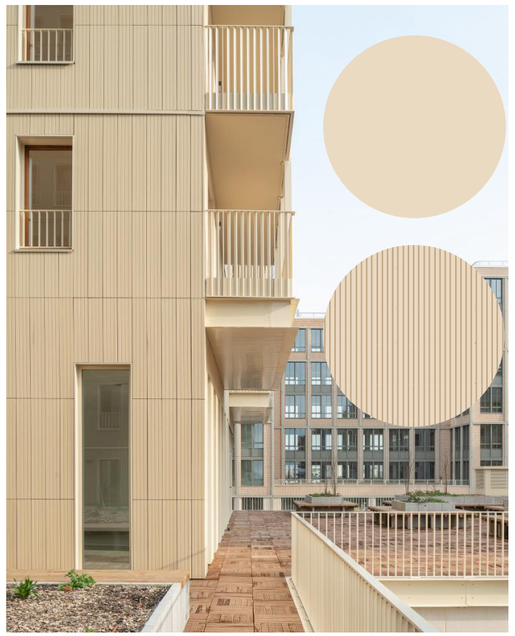
Think Green Building, Stuttgart by Bottega + Ehrhardt Architekten GmbH

Using Equitone Fibre Cement Facades



I see Vilnius, Vilnius, by Džiugas Kisielius

Using Equitone Fibre Cement Facades



Athlete’s Village, Lot E2B

Cobe Architects, Saint-Ouen-sur-Seine, France

I like the full pale yellow look.

L. Cladding Research

Extract from Duurzame Gevelmaterialen, by Merwede LAB (2025)

naam	wat	merk	kenmerken / textuur / kleur	biobased / wat is het?	brandklasse	ophangsysteem – losmaakbaarheid	
traditioneel	aluminium plaat		vlak	nee aluminium	B	geschroefd op achterconstructie of onzichtbaar bevestigd op ophangsysteem	
	aluminium plaat		geprofileerd	nee aluminium	B	geschroefd op achterconstructie of onzichtbaar bevestigd op ophangsysteem	
	aluminium composiet	bijv. aluco-bond	vlak of geprofileerd	nee aluminium met een kern van mineraal	B	bevestigd op ophang systeem	
	staalplaat	bijv. MCS	geprofileerd	nee staal	B	geschroefd op achterconstructie	
Neolife Cover	Houtvezel composiet	Neolife	geprofileerd, 8 tinten beschikbaar (aardse kleuren)	Ja, 91% 75% houtvezels, 16% minerale zouten	B	geschroefd op achterconstructie	
Resysta	Rijstvliescomposiet	Fiberplast	latten, 20mm, verschillende kleuren, vergrijsd nauwelijks	Ja	B1 (indien behan-deld)	geschroeft op achterconstructie (houten latten) of gevelprofielen	
chosen material							
Nabasco 8010	biobcomposiet van hernieuwbare materialen (bijv. hemp, vlas, bamboo) en onthardingskalk met gedeeltelijk bio-based hars	NPSP	verschillende pigmenten, glad	Ja 85% biobased	B	geschroefd op achterconstructie	

L. Cladding Research

Extract from Duurzame Gevelmaterialen, by Merwede LAB (2025)

	prijscategorie*	garantie	CO_2	levens-duur	toegepast / beschikbaarheid	opmerkingen / aandachtspunten	duurzaamheid score**
	€€ €300-325 /m²	10 jr	42,8 kg CO_2eq/m² (Zweedse NMD, 2mm)	60 jr	The Beacons, Amsterdam (Paul de Ruiter Architects)	losmaakbaar detailleren zodat het materiaal goed recyclebaar is	D
	€€€ €325-375 /m²	10 jr		60 jr	Clubhuis Amsterdamsche Football Club (Paul de Ruiter Architects)	prijs is gebaseerd op standaard handels profilering,	D
	€€€ €375-425 /m²	10 jr	26,7 kg CO_2eq/m² (EPD, A1-3)	50 jr		materiaal is zelf slecht losmaakbaar, dus slecht recyclebaar	E slecht herbruik-baar
	€ €200-250 /m²	10 jr	54,7 kg CO_2eq/m² (Zweedse NMD, 2mm)	>40 jr	Oostenburg, Amsterdam (PDR)	losmaakbaar detailleren zodat het materiaal goed recyclebaar is. Prijs is afhankelijk van dikte staal 1mm dik en eenvoudge profilering.	D
	€€€ €350-400 /m²	10 jr	21,6 kg CO_2eq/m² (Cat 1, NMD) – RZ	50 jr	Biosintrum (PDR), Basisschool de Lanen (PDR)	in 3 maten beschikbaar, Cover 6, 14 en 40. voldoet niet aan rook eis S1. 100% upcyclebaar	A
	€€ €250-300 /m² (prijspeil nov 2022)	15 jr	opgevraagd – RZ	30 jr	Rijnvliet Oost (Zecc), Zuidkade (Zecc)	Hoek- en kozijnprofilering. voldoet niet aan rook eis S1. Beplating zet uit; om kromtrekken te voorkomen, voldoende ruimte aan boven- en onderzijde vrijhouden	B vanwege krom-trekken
	€€ €300-400 /m² (schatting)	10jr	nog niet beschikbaar	50 jr	Gasopslagstation (Studio Marco Vermeulen)	6mm tot 12mm (voor bijvoorbeeld begane grond), maximale maten plaat 3700x1000mm. neggeafwerking €100/ kozijn 100mm diep, bij lengte 9 m rondom	B nog niet veel toegepast

L. Cladding Research

Extract from Duurzame Gevelmaterialen, by Merwede LAB (2025)

naam	wat	merk	kenmerken / textuur / kleur	biobased / wat is het?	brandklasse	ophangsysteem – losmaakbaarheid	
FibreC	decorative on one or both sides of the panels.	Rieder	mat, ruw	nee	A1	geschroefd of verlijmd op achterconstructie	
Rockpanel	steencomposiet	Rock-panel	verschillende kleuren	steenwolvezels	B	geschroefd op achterconstructie (schroeven zichtbaar)	
Steni Color / nature	polymeer & steencomposiet	Steni	60 verschillende kleuren en glansgraden. ook natuurlijke afwerkingen	polymeercom-posiet met een kern van gemalen natuur-steen, versterkt door een laag glasvezel	B	geschroefd op achterconstructie (schroeven zichtbaar)	
CeramicFacade	Keramische panelen	Tonality	geglazuurd/ mat (nuance)	nee	A1	geklikt in metalen profielen (droog: geen lijm/mortel nodig)	
Kerloc	vezelversterkt koud keramisch materiaal	Martens groep	korrelig, natuurlijk ogend, breed assortiment aan kleuren	ja	A2	geschroefd op achterconstructie, kan blind of in zicht	

* beoordeling is relatief, ten opzichte van elkaar. prijspeil door BBN najaar 2023 (incl. achterconstructie) niet obt offertes maar met ervaringsgetallen.

** beoordeling is relatief, ten opzichte van elkaar. onderhoud is hierin meegenomen

L. Cladding Research

Extract from Duurzame Gevelmaterialen, by Merwede LAB (2025)

	prijscategorie*	garantie	CO_2	levens-duur	toegepast / beschikbaarheid	opmerkingen / aandachtspunten	duurzaamheid score**
FibreC	€€€€ €400-450 /m²	10 jr	21,72 kg CO_2/ m², (EPD) bij dikte 13mm	50 jr	Kledingwinkel, Parijs	Zo goed als naadloos in verstek te verlijmen/ monteren. Prijs is gebasserd op neggekanten ca. b=200/ 250 mm	D
Rockpanel	€ €190-225 /m²	15 jr	13,97 kg CO_2eq/ m² (Cat 1 NMD, 8mm, rockpanel durable)	50 jr	Havep (PDR)	kopse kanten niet in kleur. bevestiging goed zichtbaar. volledig recyclebaar	C
Steni Color / nature	€€ €300-350 /m²	40 jr	14-17 kg CO_2/ m² (Henning Larsen	60 jr	Steni Color: Cornelius Haga Lyceum (OPEN architects | Mulders vandenBerk Architecten)	zichtbaar bevestigd. heeft hoekomzetting elementen. komt uit Noorwegen. let op (standaard) afmetingen van de platen. heeft ook beplating met A2 brandklasse	C
CeramicFacade	€€€€ €450-500 /m²	40 jr	47 kg CO_2/ m² (Henning Larsen), 65,2 kg CO_2-eq/ m² (Cat 3 NMD, incl. bevestiging)	100 jr	Cobercokwartier (Zecc), Witt Woerden (Zecc)	veel mogelijkheden mbt oppervlaktebehandeling, géén onderhoud benodigd, hergebruik mogelijk. Prijs is gebasserd op vlakke keramische tegels, ONGEGLAZUURD indien geprofileerd cq geglazuurd dan bijna het dubbele prijs	D
Kerloc	€€€€€ €600-650 /m²	20 jr	8-11 kg CO_2eg/ m² (Henning Larson), 15,4 kg CO_2/m² volgens EPD			10mm, maximale afmetingen van 1500x450mm	B

L. Cladding Research

Extract from Ceramic Facade Systems, by AGROB BUCHTAL (2020)

KeraTwin® K20

Panel with irregular grooves
(cross-section 8)

Grooved panel
(cross-section 1)

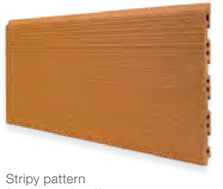
Grooved panel positive
(cross-section 2)

Shed profile
(cross-section 4)

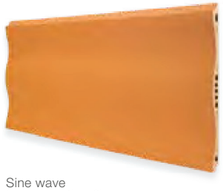
New Wave
(cross-section 7)

Smooth
(standard)

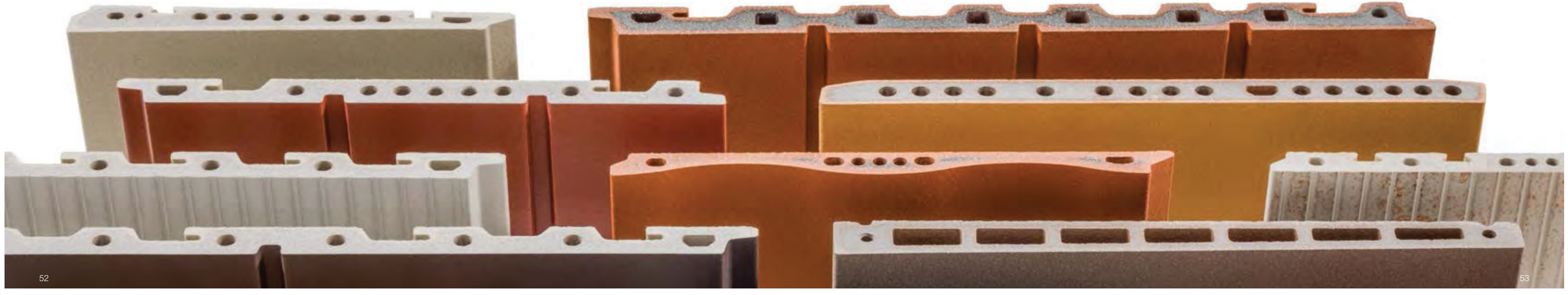
Brushed surface KeraTwin® –
special color sandstone
sandstone glazed
(cross-section 5)



Stripy pattern
(cross-section 3)



Sine wave
(cross-section 6)



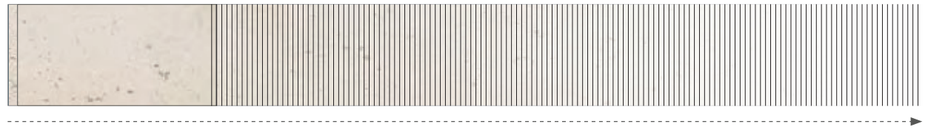
L. Cladding Research

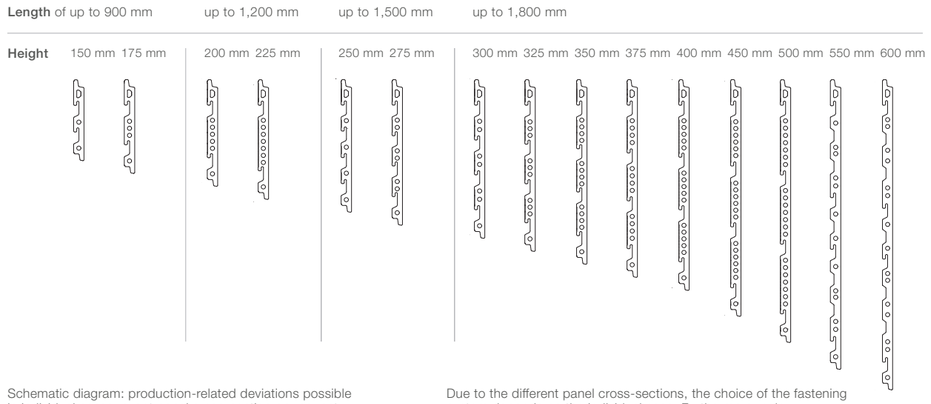
Extract from Ceramic Facade Systems, by AGROB BUCHTAL (2020)

KeraTwin® “Extruded Ceramic Panels, Precision, with an average water absorption of 3 % < E ≤ 6 %, group AII_a, part 1, annex B, glazed (GL) and unglazed (UGL)”

KeraTwin® “Extruded Ceramic Panels, Precision, with an average water absorption of 6 % < E ≤ 10 %, group AII_b, part 1, annex D, glazed (GL) and unglazed (UGL)”

Lengths of up to 1,800 mm (in 1 mm steps)





Schematic diagram: production-related deviations possible in individual cases; exact panel cross-section on request.

In addition to the variants shown, other, individual developments are possible on request.

The technical realization of the color design partly depends on the cross-section geometry. We will check this on request.

Due to the different panel cross-sections, the choice of the fastening system depends on the individual case. Furthermore, color deviations compared to the standard variants can not be excluded.

KeraTwin®

GRADUATION REPORT

Mila Giovacchini

Advanced Housing Design: Ecologies of Inclusion
MSc Graduation Studio
TU Delft, 2025-26